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MANUALS

FOR

STUDENTS OF MEDICINE.

ELEMENTS

OF

SURGICAL DIAGNOSIS.

BY

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PREFACE.

My chief object in writing this book has been to state, so far as lies in my power, those principles of diagnosis which apply in all cases and under all circumstances. The application of these principles to the diseases and injuries of various regions has been given as fully as possible.

I have thought it best to separate the diagnosis of injuries from that of diseases. While aware that this course is not in strict accordance with the ways of Nature, it has yet seemed to possess the advantage of greater simplicity, and I trust that it will not interfere with any usefulness the book might otherwise have.

I have great pleasure in acknowledging the able assistance I have received from my friend, Dr. Angel Money, who has kindly revised the proof-sheets, and made many valuable suggestions.

In view of the importance and difficulty of the subject, it is with great diffidence that I venture to submit this manual to students and practitioners of surgery.

A. PEARCE GOULD.

16, ***Queen Anne Street, W.***

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SURGICAL DIAGNOSIS.

CHAPTER I.

INTRODUCTORY.

THE art of diagnosis is that by which different things are distinguished from one another. The use of the term "diagnosis" is almost limited to medical literature, and there it is employed in two senses: first, to signify the process whereby we arrive at the distinction between different morbid states; and, secondly, to signify the result of that process. Hence the "diagnosis" of a case is oftentimes synonymous with the name of the disease or injury from which the patient is suffering. In this book an attempt is made to study the process of diagnosis, and to put the student in possession of knowledge, the application of which to any given case will enable him to determine the nature of the patient's ailment.

There is no natural distinction between medicine and surgery, but a separation of medical and surgical affections is so convenient, and is so generally understood and approved, that no excuse for dealing with the subjects of medical and surgical diagnosis in two volumes need be given. It has been thought best to limit the subject of surgical diagnosis by excluding reference to surgical affections of the eye, ear, larynx, and the female pelvic viscera, partly because this is in accord with a prevailing custom, and mainly because it would require too much space to discuss the various special means of diagnosis, instrumental and other, which have been introduced by those who have devoted themselves to the study of these diseases. My aim is to afford a guide to the diagnosis of those cases of injury and disease which may be met with in the surgical wards and out-patient rooms of our hospitals. If some of my readers are disposed to cavil at the limits I have assigned myself, I would remind them that all sound *principles* of diagnosis are of general, not merely of local, application, and may be employed with as much confidence in the special surgery of the eye, ear, larynx, and pelvis, as in what is known as the general surgery of the trunk and limbs, and that all that is required in any case, in addition to the principles of diagnosis, is correct anatomical and physiological knowledge, aided by acquaintance with the methods of investigation of the particular organs. At the outset I would urge upon the student the importance of grasping the fact that the *principles of diagnosis* are of more value and importance than any given application of them, and that he should endeavour always to look through and behind the application to the principle itself. In other words, the knowledge of *why* certain signs or symptoms justify or compel a given diagnosis, is the key to correct diagnosis, and is the essential point for students to grasp. For this reason I shall make but very scant reference to so-called "pathognomonic signs" or "diagnostic tips," which are of value, if at all, only to the experienced, and to the beginner are both sources of danger and the promoters of evil habits of mind. Similarly, tables of comparative diagnosis have been discarded. It is impossible to sketch Nature in parallel columns; and although such a method may be useful for showing in a graphic manner the resemblances and the differences of allied affections, it is an artificial and, in my opinion, a false method when applied to the purposes of practical diagnosis. Upon the importance of diagnosis it is only necessary to say a word. Viewed in its wide and true sense, diagnosis is the essential preliminary both of successful treatment and of a just prognosis; and, although the present want of correlation between it and therapeutics forms a strong temptation to carelessness in diagnosis, it is evident that this correlation, so earnestly desired by every true surgeon, is only to be secured by a patient and painstaking study of the facts of each of these sciences. The fact that a surgeon's treatment is the same for two or more similar affections affords no justification for his failure to distinguish between cases of such affections.

The art of diagnosis can be carried to very various degrees of perfection; it is therefore necessary to remind the student that merely to assign a name, even when it is correct, to a disease or injury, may fall far short of a satisfactory diagnosis. It may be admitted that there are certain refinements of diagnosis, the practical value of which is not at present appreciated, at any rate by the majority of surgeons, and in reference to which two remarks seem called for: all such "refinements," when expressions of truth, are to be valued, and even when their practical bearing upon therapeutics and prognosis is not apparent, they must be followed out, with confident assurance that their practical benefit will become evident; but they must be carefully regarded as "refinements" and not as "essentials" in diagnosis, and only those who are masters of the art should draw them, for it is as disastrous as it is foolish for mere tyros to attempt "to run before they have learned to walk."

One of the most important points to be constantly borne in mind, is the fact that the surgeon has not simply a disease or injury to diagnose, but a diseased or injured man. There is a great tendency to concentrate the thoughts solely upon some local lesion, and to ignore the individuality of the patient; and there is the greater tendency to this from the extreme difficulty of estimating in many cases the "personal equation" of patients, and from the close attention that must of necessity be given to the features of all local lesions, as well as from the fact that our clinical distinctions and nosological names depend in nearly all cases upon local manifestations of disease. This leads me to observe that a complete diagnosis in most cases includes three elements. There is first the recognition of the anatomical features of local lesions; then their physiological or pathological characteristics; and, lastly, the constitutional change either leading to or resulting from the local lesion. For example, to take such a simple case as an enlarged gland in the groin. The first step in the diagnosis will be the recognition of the anatomical nature of the swelling present, the fact that it is an enlarged gland and not a hernia, a varix, or a fatty tumour, etc. But this must be complemented by an inquiry into the nature and cause of the enlargement, whether it be inflammatory or neoplastic, whether the result of the absorption of irritating matters from an inflamed urethra, a chancre, or a sore on the foot, or the result of syphilitic or of cancerous infection, or, again, a part of the local manifestation of erysipelas, or a primary affection of the gland, as in Hodgkin's disease. When the pathological nature of the lesion is known, inquiry must still be prosecuted to ascertain how far the general system is implicated, whether primarily or secondarily, as by fever, exhaustion, anæmia, etc. These three parts of a diagnosis do not require to be separately followed out in all cases, but they are so intimately connected together that the threefold nature of a complete diagnosis is, for that very reason, in danger of being lost sight of.

The general method of diagnosis varies with different surgeons; some prefer to obtain first a complete history of the case, and then to make their examination of the lesions presented; while others first make their examination, and then investigate the history of the case. There is much to be said in favour of each plan, and probably each is specially suited to certain forms of disease and injury, and he will be the best diagnostician who knows when and how to employ either as may be most desirable. For beginners, however, the former and more laborious plan is much the best, as otherwise important points will be overlooked; and it is only safe to practise the more direct method when clinical experience has developed that instinct which enables a surgeon to elicit just those points in the history of a case that have a real bearing upon the diagnosis. The particular methods of diagnosis vary with the general character of the case, and with the locality of the affection. I shall try to indicate these in their proper places, and would here only mention that there are many plans which may be adopted, and possibly with equal advantages. The same case is approached in different ways by different minds, and the student must not look for uniformity among his teachers, nor can the author claim anything more for the methods and schemes advocated in this book than that he has found them to be practical and reliable.

Nothing will conduce more to the formation of habits of correctness in diagnosis than the practice of note-taking and of committing to writing the diagnosis of a case and the reasons to be urged in support of it. I would venture to press this point upon the attention of students, and to assure them that any time so spent will yield them a full reward in the readiness, confidence, and accuracy in diagnosis it will produce.

But of far greater moment than the method employed is the precision and soundness of the data on which the diagnosis rests, and it is to this that students must first and chiefly direct their attention. Books and didactic instruction can give them but little aid here, and they must rely upon practice and the education of their senses. Care is required in making even the simplest observation, such, for instance, as counting the pulse or measuring the length of a limb. Students from the first should form the habit of taking *single precise* observations, and not trust to mere repetition for ensuring accuracy. It is only too common to see the manipulation for the detection of fluctuation repeated several times before the observer is sure of the result; similarly, a patient with a scrotal tumour is made to cough several times, before it is decided whether the act causes any impulse in the swelling or not; and many other similar examples might be given. All this is bad, and the student from the first should set his face against it, and endeavour as far as possible to obtain a thoroughly trustworthy result from a single observation; not only does this save time, but it often saves pain to the patient, and, by demanding a concentration of attention, does much to secure the condition most of all necessary to ensure accuracy of observation. It is not intended that where a single observation leaves a doubt upon the observer's mind it is not to be cleared up by a repetition of the observation, but only to insist upon the great value and importance of forming the habit of relying upon a single observation, and so of reducing to a minimum the occasions when its repetition is necessary.

It is well always to bear in mind that clinical data vary widely in value. Thus, as a rule. positive data are of more importance than negative; for instance, the detection of fluctuation in a swelling is proof of the presence of fluid in it, but the failure to detect fluctuation cannot always be accepted as proof that the swelling is wholly solid; similarly, the detection of translucency in a scrotal tumour will prove it to be a collection of serous fluid, but its opacity is not an absolute proof that it is not a hydrocele, for there may be some special condition preventing the transmission of rays of light. This applies with even more force to the facts stated by patients or their friends than those observed by the surgeon. The fact that pain has been experienced or complained of, or that swelling, or discoloration, or some functional disturbance such as lameness, or nutritive change such as wasting, has been observed, must be accepted as of distinct and positive value. But the absence of any such history is of very different import, for it may depend not only upon the absence of these conditions, but also upon failure to observe them, upon forgetfulness, or even upon a wilful concealment of the truth. For example, it is not uncommon to find patients suffering from secondary syphilis quite unconscious of the existence of the rash or of the sore throat, and such patients, questioned years after as to the occurrence of such phenomena would of course reply in the negative, and might therefore mislead the surgeon.

Still more must such a distinction be drawn between objective and subjective phenomena, between those which can be ascertained by the surgeon himself and those for which he has to rely upon the word of the patient alone. With due care, skill, and some practice, the surgeon should in nearly all cases be able to determine the objective phenomena without doubt or error. Patients are rarely content to state subjective phenomena without either some exaggeration, or, more often, an attempt to interpret them. It may be quite impossible to eliminate the error arising from conscious or unconscious exaggeration, but the surgeon should always be careful so to form his questions as to conceal, so far as may be, his object in asking them, and so as to elicit the simplest statement of facts without any added interpretations; and in every case he will, of course, reject such interpretation unless his own independent investigation of the phenomena convinces him that it is correct. Care should be taken also to distinguish between what may be called "common" and "skilled" evidence, and upon the class of facts which may be accepted on the strength of the one or only on the strength of the other. By this it is not meant that all evidence derived from a patient and his friends is "common," and only that afforded by a medical examination is "skilled." With the degrees of intelligence there are corresponding degrees of value to be attached to lay as well as to medical evidence, and the astute observer will not only be enabled to make the most trustworthy examination himself, but also to put its right value upon the evidence given by the patient, and will be able to distinguish between those statements which he may accept as valid and trustworthy, and those which he must take with the proverbial "grain of salt." To refuse to receive evidence on technical points from laymen, would be to make a mistake as great as to accept without question all evidence on technical points from every medical observer. The capacity of the observer to make the particular observation in point must be always considered and estimated. By practice in questioning, it is easy to obtain corroboration or the reverse of statements made by patients on technical points, and this should, of course, never be neglected.

It is not possible in the space at our disposal to go further into the rules of evidence and other allied questions. We have, perhaps, stated enough to indicate the importance of the subject and the necessity of acquiring proficiency in the art of obtaining the data upon which to found a diagnosis.

One other remark may be made here, and it is to urge upon students the importance of appreciating the *significance* of individual data. There is a danger lest this should be overlooked, and the deplorable habit formed of resting a diagnosis upon a mere combination of signs and symptoms rather than upon the anatomical or physiological facts of which they are but the expression. An illustration will perhaps serve to make my meaning clear. Fluctuation is a sign obtained only when there is fluid contained in a cavity of some size, and it indicates little or nothing as to the character of the fluid; and yet it is not infrequent to find beginners resting their diagnosis of abscess solely upon this one sign. The observer must look behind and beyond any symptom or sign to its explanation, meaning, or cause, and diagnosis must rest not upon symptoms, but upon the conditions of which they are the expression. This may seem a trite remark, but experience in the out-patient rooms and wards, not to mention examination halls, soon shows that, like many other trite observations, it needs to be enforced. Diagnosis rests first upon accurate observation and then upon a correct appreciation of the true significance of clinical data.

Before passing on to consider the diagnosis of individual affections, it will be well to speak in somewhat fuller detail of the various chief classes of clinical data on which we have to rely. These may be spoken of under the heads of *family history*, *personal history*, *history of the cause* or *first onset* of the affection, its *course or progress*, the "*present state*" of the patient when first seen, and the *subsequent progress* of events, including the *effects of treatment*.

Family history.—The influence of heredity upon pathological processes is both varied and occult. While in some instances we seem justified in assigning very great importance to it, in others its influence is wholly unrecognised, and between these two extremes we meet with all possible degrees of difference. It is, therefore, not a matter upon which it is possible to dogmatise or to write in a categorical manner, and it must suffice to indicate those constitutional states in the parents which are justly believed to influence disease or injuries in their offspring. Of these by far the most important is *Syphilis.* It admits of no doubt that the syphilitic taint may be inherited, but it is no less certain that all the children of syphilitic parents are not themselves the subjects of syphilis, and all degrees of intensity of the inherited taint are met with and can be recognised in practice. To ascertain that a patient is the subject of inherited syphilis is of the utmost importance; for not only may it at once determine the diagnosis, but it will exert a distinct influence upon the treatment, and in very many instances form the sole guide to the management of the case. The manifestations of acquired syphilis vary so much in kind and in intensity that it is quite impossible to state positively what does and what does not constitute a history of syphilis in the parents of an individual, and experience will alone enable the surgeon to determine upon what evidence such a conclusion may be allowed to rest. But this may be mentioned, that one objective sign of the disease observed by the surgeon is of more value than much unsupported evidence of the patient or his friends. As already mentioned, the discovery that a patient's parents were the subjects of constitutional syphilis before his birth does not of itself warrant the conclusion that he has himself inherited the diathesis, and in all such cases the supposition must be corroborated by evidence derived from the history or condition of the patient before it can be accepted. It has been clearly proved that the syphilitic taint is most often and most intensely inherited soon after it has been acquired by the parents, and that with successive pregnancies the chance of inheritance and the intensity of the inherited taint diminish. It is, therefore, of importance to get evidence upon this point, and to learn, if possible, not only whether the parents were the subjects of syphilis, but also when, in reference to the birth of the patient in question, they acquired the taint, and whether the syphilitic dyscrasia was manifested in the products of the conceptions immediately preceding and following that in point. What is known as Colles' law, that the mother of a syphilitic infant is always herself the subject of syphilis, leads us to rely more upon evidence of syphilis in the mother than in the father. In investigating a family history for inherited syphilis, two errors may be made: the infection may be assumed on insufficient evidence, or we may fail to obtain the evidence of the taint which really exists. When it is remembered how mild some attacks of syphilis are, oftentimes how little there is to attract the patient's attention to his condition and to fix it in his memory, as well as how unobservant many patients are, it is not to be wondered at that years afterwards we fail to elicit an account of troubles long ago forgotten if ever noticed at all. Many of the characteristic effects of constitutional syphilis are simulated by other conditions. For example, a series of abortions is caused by local affections of the generative organs perhaps as often as by syphilis; repeated attacks of sore throat, and "ulcerated" sore throat, are as often simple follicular tonsillitis as specific pharyngitis; while it need hardly be pointed out that sores on the genital organs leaving behind depressed scars, are so often not syphilitic in nature, or at least not Hunterian or infecting chancres, that no weight whatever is to be given to the history or objective evidence of such sores unless supported by other facts. In some cases even one fact will render the existence of syphilis in the parents beyond all doubt, such, for instance, as the discovery of a perforation of the palate; but in the majority of cases the most satisfactory evidence will consist of a series of facts in which the recognised course and progress of the malady can be traced: a single sore followed by multiple painless buboes, a papular rash over the trunk, sore throat, and perhaps mucous patches, and then, later on, sore tongue, periosteal pains and swellings and ulcerations, miscarriages, and other well-known syphilitic phenomena. The result of an examination may be given under one of four heads. Thus, in many instances we may be able to state positively, (1) that the patient's parents were the subjects of active constitutional syphilis at the time of his conception and birth; or (2) that the patient's parents were certainly not the subjects of active constitutional syphilis at the time of his conception and birth; but in many other cases, the evidence obtained will only warrant the statement (3) that the evidence is not sufficient to show that the patient inherited syphilis from his parents; or (4) that the evidence is not sufficient to show that he did not inherit syphilis.

Struma is another disease which is undoubtedly hereditary, although often acquired. Evidence of the existence of struma in a family is usually readily obtained from its characteristic effects. Phthisis, diseases of bones and joints, lupus, and lymphatic glandular enlargements, are too obvious, too chronic, and too serious in their results, to be overlooked or forgotten. A family history of *Gout* is not so easily obtained among the humbler as among the upper classes of society, where the distinction between it and rheumatism is carefully drawn. Repeated attacks of inflammation in the joint of the great toe is the sign that we have chiefly to rely upon.

One of the hereditary affections most interesting and important to the surgeon is *Hæmophilia,* and where this exists in the family, evidence of it is usually readily obtained, as the repeated and often fatal hæmorrhages are facts which strongly impress the laity. It must be remembered that inquiry is to be mainly directed to the male members of the family, as it chiefly affects them, although it is transmitted through the females.

Cancer.—The heredity of cancer, including under that head all malignant tumours, is of much less importance than was at one time supposed. Occasionally we meet with striking examples of it, as in the family of a patient recently under my care for scirrhus of the breast (the patient had lost her mother, two maternal aunts, and at least two cousins on the mother's side, from cancer); or the well-known "Middlesex Hospital case," in which a woman and five of her daughters had cancer of the left breast. The absence of all hereditary influence is very frequently observed, and this factor will scarcely influence in any way the diagnosis of the nature of a tumour.

Personal history.—By this is meant the history of the patient previous to the occurrence of the affection presented for diagnosis. This is of importance in two ways, either as indicating the existence of some dyscrasia or constitutional taint, or as revealing some habit, practice, or occupation, rendering the patient liable to particular accidents or forms of disease. When the family history shows the existence of some heritable affection in the parents or brothers and sisters, inquiry should at once be made to ascertain whether there is positive evidence of this dyscrasia having been transmitted to the patient. As already mentioned, when a history of syphilis has been made out in the parents, that alone is not a proof that the children are syphilitic, and evidence of the existence of this taint must be sought in the patients themselves. This holds true to some extent also in the case of the other heritable diseases we have mentioned, but there will be nothing to indicate the existence of the cancerous or gouty dyscrasia until the occurrence of a tumour or an attack of inflammation in the great toe, and this may be postponed for many years; but the other dyscrasiæ (syphilis, struma, and hæmophilia) manifest themselves much earlier. In reference to habits and occupations, mention may be made of kneeling, mining, working with phosphorus, mercury, or lead, the handling of hides or horses, alcoholism, exposure to wet and cold, occupations involving constant standing or contact with soot.

History of the affection.—This must be made out with great care and precision, and all dates accurately fixed, and stated in the days of the month (not of the week) when committed to writing. The earliest symptom noticed should be first recorded, and then inquiry should be made with a view of tracing out its cause, whether an injury of any kind (blow, fall, strain), over use, exposure to changes of temperature or to contagion of any kind, or the ingestion of food or medicine. The student must not accept the patient's view of the cause of his affection unless it commends itself to his own knowledge and judgment. Having obtained an account of the supposed origin of the affection, note carefully its exact course, and the order, mode, and time of development of any changes in it, together with the effects of any plan of treatment that may have been adopted. The bearing that these facts has upon diagnosis varies much in different cases, and will have to be discussed in succeeding chapters; but we may here make a few brief general remarks upon the subject. And first, as of most moment, comes *the influence of injury* of every kind; this is most apparent in a large class of cases such as wounds, fractures, sprains, etc., which will be dealt with apart from so-called "diseases" in the earlier chapters of the book. But there are cases in which the influence of traumatism is less certain: first, because we do not know how far slight injuries may act as exciting causes of the growth of tumours or of some other diseases; and next, because such an injury may be merely the means of attracting the patient's attention to a pre-existing morbid state. For instance, a blow is often alleged to be the exciting cause of a tumour of the breast, when it may merely have led a patient to make an examination of the part and detect a lump, which, not being painful or protuberant, had previously escaped observation. The only way of avoiding this error is to ascertain as accurately as possible the succession of events and the relation as to time of the injury and any signs or symptoms of disease. The *mode of progress* of the disease may be an important factor in diagnosis; for while any disease may steadily advance, only certain forms are capable of spontaneous recession, or of an intermittent or remittent course. It is a marked characteristic of all forms of malignant growths that they continuously and generally rapidly increase; and while simple tumours may run a similar course, yet they not unfrequently remain stationary for an indefinite period, or recede. The mere duration of an affection may in the same way exclude some forms of disease, as, for instance, malignant growths and acute inflammation. The *sequence of symptoms* is sometimes of importance, as, for example, where renal colic is followed by signs of vesical calculus, or where the apparent reduction of a hernia is attended with no relief to, but rather an increase in, the severity of the signs of strangulation of the bowel. The *relative intensity* of various symptoms may aid in the diagnosis; thus, the absence of pain may exclude acute inflammation, or the frequency and amount of vesical hæmorrhage may clearly connect any other urinary symptoms with the presence of a tumour in that viscus. Lastly, the relation of any *constitutional state,* such as anæmia, wasting, jaundice, or other cachexia, may indicate whether it is the cause or the result of some local morbid state.

The examination of the patient will now follow, and should in all cases be as complete and careful as possible, no point being omitted because of its apparent want of bearing upon the case; for it must always be remembered that we have to deal with patients, with men and women, not with diseases: we must not, therefore, limit our attention to some merely local lesion, or even some constitutional change, but must try to view each patient as a disordered man. The interest and practical importance of local lesions or of general diseases is so great, that there is a grave danger lest in our view of the disease we lose sight of the subject of it. The results of our examination of the patient are, of course, the most important for purposes of diagnosis; for the evidence so obtained may be mostly, if not wholly, objective, and will also be entirely skilled evidence. To show how the data thus obtained, combined with others, enable us to diagnose various morbid states is the chief burden of the following chapters.

What has been said as to the progress of the case as stated by the patient himself in relating its history, applies equally to the changes, or lack of change, observed by the surgeon himself. In reference to the *results of treatment,* special significance is to be attached to the influence of what are known as "specifics," such for example as mercury, iodide of potassium, and quinine; but scarcely less important are the results of general tonic treatment, or of rest, counter irritation, and of surgical operations. It remains but to add a few words upon the general *method of examination.* First of all it should be *systematic* and *purposive;* the investigation of symptoms should be conducted in some regular order, and each question, each manipulation, each part of the examination, should have some definite object or objects in view. To conduct an examination in this way not only promotes accuracy of diagnosis, but it tends also to facilitate and expedite it, because it necessitates the surgeon using his mind and his senses together. Its value is often conspicuously seen in the way two men will examine a tumour, one of whom in a few brief moments will have learnt all its characters, while the other, after a more prolonged examination, will have ascertained little or nothing about it, and will be unable to speak definitely and with assurance as to its nature; and this may not be so much from want of absolute knowledge, as from ineptitude and the want of a definite aim and purpose in his examination. Similarly, *precision in result* must be attained whenever possible; there are many cases where it is unattainable, but it is safe to say that this should neither be taken for granted, nor admitted until an attempt has been made to eliminate all elements of doubt and inaccuracy; whenever the results of examination can be stated in numbers, this should be done, as in the case of the temperature, pulse, respiration, measurements of all kinds, number of fits, frequency of micturition, etc. As far as possible, objective and subjective phenomena should be separately investigated, and the latter must be carefully analysed. Patients will frequently describe their sufferings or their sensations by inaccurate language, and the surgeon must seek by careful questioning to obtain objective evidence of subjective phenomena. For instance, a patient's statement that he cannot swallow must not be accepted until his attempt and failure to do it have been seen; in this, as in many other like cases, pain in an act is often spoken of by the sufferer as inability to perform it. Lastly, as already mentioned, the examination must be *complete*, and include the entire patient, with all his functions. It is only too true, that from various reasons this latter point is often neglected; the omission may be condoned, but never justified, and while it often results in serious error, it is never without some risk.

Certain symptoms we shall have to speak of so often, and are so important, that they merit and must receive separate consideration. Of these, swelling, ulceration, and gangrene, will be dealt with in subsequent and separate chapters; redness and pain may be discussed here.

Redness.—The first point to be settled in regard to redness of a surface is the cause of the discoloration, whether it is dependent upon excess of blood in the vessels of the part (hyperæmia) or upon extravasation of blood from the vessels. This is easily ascertained by noticing the *effects of gentle pressure* upon the part; when the condition is one of hyperæmia, such pressure displaces the blood in the vessels and causes a momentary blanching, while it has no effect whatever upon petechiæ or larger blood extravasations. By observing also the rapidity with which the blanching produced by pressure passes off and the blood returns into the emptied vessels, an estimate of the freedom and rapidity of the local circulation can be formed. In acute inflammation, for example, the redness generally entirely disappears on pressure, but quickly returns when the pressure is removed. In the congestion of a part approaching gangrene the redness may still be made to disappear on pressure, and then only slowly reappears. The eruption of purpura or the discoloration of a bruise, is entirely unaffected by pressure. Cases may of course occur where the redness of a surface is merely the result of the application of a dye, such as magenta, either accidental from the contact of dyed stockings or other clothing, or intentional on the part of malingerers. In the one case its position and extent will suffice to prevent error, while in both cases alike the peculiar colour, unlike that due to hyperæmia or hæmorrhage, its superficial character, the fact that it is at the same time bright, intense, diffused, uniform, and yet unaffected by pressure, together with the absence of local heat or swelling or other signs usually attendant upon such marked hyperæmia, and the results of a diligent application of soap and water, will reveal the true nature of the case. This is the most important of all the particulars to be noticed in reference to redness. Next in importance in the cases of hyperæmia comes the *colour of the redness,* which depends upon the state of oxygenation of the blood in the vessels; a purple or livid colour may depend upon a general de-arterialisation of the blood from structural or functional derangements of the heart or lungs; upon local conditions, the hyperæmia being mainly or entirely venous, or the circulation in the part retarded, and the regular interchange of gases greatly increased in amount. Very important deductions, therefore, can be made from the colour of a hyperæmic surface; its lividity may prove a measure of general systemic failure reacting upon the heart and lungs; while in other cases similar lividity may indicate local obstruction to the return of blood from the part. The difference between this local lividity from obstruction and that from venous hyperæmia without obstruction, such as is seen in the final stages of inflammation, in venous nævus, and in some other cases, is that the effect of pressure is slowly recovered from in the former case, and very rapidly in the latter; and in the latter case, too, the individual dilated veins are oftentimes to be seen. Closely connected with this is the *temperature of the part;* where hyperæmia is combined with increased heat it indicates that there is a rapid circulation, and a rapid renewal of the blood in the part; where, on the other hand, a hyperæmic part is cold, it shows that the circulation is torpid, and that the blood travels so slowly through the superficial vessels that it loses a considerable amount of its heat. The intensity of the redness and the extent of tissue affected are points easily observed, and the significance of them is quite obvious. It should also be noticed whether the redness is *associated with swelling*, and an attempt be made to gain an estimate of their dependence one upon the other. Marked hyperæmia may be quite unattended with appreciable swelling (a familiar example of this is afforded by blushing); it may be attended by slight swelling, as in cutaneous erysipelas; or associated with intense swelling, as in phlegmonous erysipelas or in œdematous intertrigo. Where redness is one of the phenomena of inflammation, swelling will always be found with it, it may, however, be so little marked as not to be noticeable as enlargement of the part so much as a certain increase in its tension, or a hardness of the tissue. It may be well to point out here what are the various associations of redness and swelling. (1) They may be joint phenomena of the process of inflammation; (2) hyperæmia, especially when passive or obstructive, leads to œdema or transudation of the liquor sanguinis; (3) by the growth of tumours the deep veins may be pressed upon, and the stress of the circulation thrown upon the superficial vessels may then cause hyperæmia, or the tissues around a tumour may participate in its extreme vascular engorgement; (4) greatly swelled parts may become hyperæmic, or even inflamed, as the result of friction or the prevention of cleanliness, or of the proper evaporation of irritating cutaneous secretions; the patches of intertrigo in connection with large pendulous tumours, scrotal hernias, or the œdema of Bright's disease, afford illustrations of this.

Finally, the association of *alteration of sensation* with hyperæmia is to be noted. Inflammatory hyperæmia, indeed all active hyperæmia, is always attended with pain and increased sensitiveness. When, on the other hand, there is a combination of numbness, or loss of the normal acuteness of sensation, with hyperæmia, it indicates a failure of the local processes of nutrition, unless indeed the two phenomena own one common cause in some affection of the central nervous system, which will be shown by other signs, and especially by motor paralysis.

Pain is a symptom which more often than any other is presented to the surgeon, and the importance of which, from a diagnostic point of view, cannot be overrated. For a full and worthy consideration of the diagnostic value of pain, the reader is referred to Mr. Hilton's classic lectures on "Rest and Pain;" our space will only allow us to notice some of the principal features which should be noted in the investigation of pain. The first of these is its *exact seat;* this is of value in two ways; in the majority of cases it directs attention to the affected parts, and by localising the pain we are able to localise the disease; in other cases the pain is found to correspond to the distribution of a particular branch or trunk of nerve, and when this is the case it should lead us to look for the cause of the pain, not in the area of peripheral distribution of the nerve, but in some affection of the trunk or root of the nerve. The reason of this is that purely local (that is, peripheral) causes of pain are not limited by the distribution of particular nerves; while causes of pain acting upon nerve trunks or their roots are referred to the exact peripheral distribution of the nerves affected. But it must also be remembered that an irritation acting upon one branch of a nerve may be referred as a pain to the terminal offsets of the nerve, and the pain experienced in the knee in many cases of disease of the hip-joint is a well-known example of this fact. Hence, where the area of a pain does not correspond to the exact distribution of any given nerve or nerves, a local cause for it may be sought; but when, on the contrary, the painful area is sharply limited to parts supplied with sensation by a particular nerve or nerves, some cause acting upon this nerve trunk or its root, whether inflammatory, compressive, destructive, or reflex, must be sought.

Much light is afforded by noticing whether *hyperæsthesia* is associated with pain, and if so how this hyperæsthesia is elicited. For example, the absence of all tenderness to pressure or movement in a painful part is strong evidence that the source of the pain is not local, but central or referred; for instance, when pain is complained of in the knee, and the part is found free from all tenderness to pressure or movement, there will be no doubt that the source of the pain is not in that joint, and probably it will be discovered in the hip-joint. Other illustrations are afforded by the pain felt in the foot in cases of aneurism pressing upon the internal popliteal nerve, or the pain in the testicle in cases of renal calculus. The surgeon must make this examination with caution, because the association of pain and tenderness is so frequent, and probably in the patient's experience so constant, that he will thoroughly expect pressure or movement to give pain, and he may be so much on the alert to detect its first onset, that he may unconsciously deceive the examiner; his suspicions and his alarms must be allayed. The converse of the above statement does not hold good, for tenderness may be elicited where the cause is central or referred, as, for instance, in some cases of neuralgia, and in some cases of pain in the knee from disease of the hip; but most markedly of all is this met with in hysteria. The manner in which the hyperæsthesia is elicited greatly aids in diagnosis; if, for instance, the lightest contact causes pain it indicates affection of the cutaneous nerves; if the skin can be handled freely, perhaps pinched up without causing pain, while pressure upon the deeper parts (muscles or bones) excites pain, it shows in the same way that these deeper structures are affected; this mode of diagnosis is constantly employed in the recognition of intercostal myalgia, and there are many similar instances. Where the hyperæsthesia of the subcutaneous tissues is very intense, and they lie superficially, as, for instance, in the case of periostitis over the inner surface of the tibia, the gentlest pressure upon the skin is at once transmitted to the inflamed periosteum, and causes pain, and great care must be used in applying this test. Very similar information is afforded by observing the *effect of movement* upon pain. The stretching or compression of any inflamed part, or the contraction of an inflamed muscle, is painful. Hence, if it is found that a certain active movement, *e.g.* abduction of the arm, is painful, but that the arm can be put into the same position by the surgeon without causing any pain provided the patient's abductor muscles are all kept relaxed, it will show that it is really the contraction of these particular muscles, and not this position of the limb, that is painful; the precise seat of the pain will thus have been determined. The same test may be applied in a similar manner to other muscles.

But it will further be found in these cases that placing the parts in such a position that the affected muscles are stretched will also elicit pain; for instance, in a case of myalgia of the deltoid muscle, active abduction of the arm will give acute pain, passive abduction will be painless, and extreme adduction, whether active or passive, will be painful. Ligamentous pain is elicited by any movement, whether active or passive, that stretches the ligament. Hence by the careful and intelligent use of this sign we are able to distinguish between muscular and ligamentous pain. Take such a case as is presented in "stiff-neck," and we will suppose that the patient has pain on turning his face to his left shoulder, the pain being limited to the right side of the back of the neck; if we find that the surgeon can turn the patient's head to the left without causing pain, but that when he moves the face far to the right he elicits sharp pain, the pain evidently is muscular; but if the pain is just the same whether the face be turned actively or passively to the left, while no pain is produced on turning the face to the right, the pain is evidently situated in those ligaments which are stretched when the face is turned to the left, and not in the muscles. There is a considerable range of movement in all joints in which no ligament is placed on the stretch, but during which the articular surfaces are in contact, and passing over each other with more or less pressure; hence, if such range of movement be painless it is a good indication that the articulation itself is not the seat of the painful lesion; while, on the other hand, if passive movement to any extent, and in every direction, is painful, it clearly shows that the interior of the articulation is affected. Quite similar principles find a somewhat different application in special situations, as, for example, in the bladder, where the pain in vesical calculus is specially caused by the contraction of the bladder on the stone, and is relieved by the passage of some urine into the bladder to re-distend the viscus off the surface of the stone. In acute cystitis, on the other hand, the chief pain is produced by the contact of the urine with the inflamed mucous surface, and by the contraction of the inflamed muscular tissue, and it is relieved immediately after the act, to be again exaggerated as the urine accumulates. The knowledge of the way in which the pain is spontaneously produced or increased has for its object the same purpose. By the *character* of the pain something may at times be learnt; the itching, burning, smarting pain of cutaneous and mucous inflammations, the deep boring and aching pain of bone inflammations, the shooting, lancinating pains of "neuralgic" origin, or of those due to central lesions, and to pressure upon and partial destruction or inflammation of nerve trunks, and the "lightning-like" pains of locomotor ataxy, are all illustrations of this fact. Paræsthesia or anæsthesia with pain is most frequently due to central nervous lesions, but may be purely of local origin, as in the case of commencing gangrene. When there is a history of severe or of long-continued pain, it should be carefully observed whether there is any evidence of the *constitutional influence of the pain.* Pain exerts a depressing influence upon the central nervous system, and when intense or very prolonged its ravages are always visible. If, therefore, the account of the pain given by the patient corresponds with the *facies*, it receives important corroboration. If, on the other hand, there be no correspondence between the two, if with cheerful face and healthy countenance a patient describe himself as in great suffering, or as having recently suffered severely, and for a long time, it will convince the surgeon that the statement is exaggerated, or that the pain is purely functional hysteria, not that it need be any the less real. Such a fact may render important aid in diagnosing hysterical pains, and may then usually be corroborated by finding that when the patient's attention is engaged elsewhere he permits of pressure, manipulations, and movements, which when his attention is directed to the part he would have described as "distracting," or "intense," or "unbearable," or by some similar term. This correspondence of all the facts about a given pain is a point which may enable the surgeon to give an opinion even in otherwise very difficult cases.

CHAPTER II.

THE GENERAL DIAGNOSIS OF INJURIES OTHER THAN WOUNDS.

It is important to remember that more than one lesion may be produced by a single injury or accident, and that it is the duty of the surgeon not only to determine that a certain lesion, *e.g.* a fracture, has been produced, but also to exclude every other, *e.g.* a ruptured artery, severe sprain, and so on. Errors, sometimes of grave consequence, are made by failing to make a *complete* diagnosis. In conducting an investigation for this purpose it is best to examine each structure separately and in succession, beginning with the skin and subcutaneous tissue.

1. **Examine the skin and subcutaneous tissue, noticing especially discoloration and swelling.**

(*a*) If the skin be discoloured dark-red or reddish purple, and the colour be unaffected by pressure, there has been an escape of blood from several small vessels, a *bruise.* This effused blood goes through the well-known colour changes, and if seen late may cause merely a yellow stain. If the dark-red discoloration appear at some interval after an injury it points to a *deep bruise*, the blood escaping from deep vessels gradually reaching and staining the superficial tissues; this phenomenon is sometimes witnessed in fractures of the neck of the femur.

(*b*) If immediately or very rapidly after an injury a distinct fluctuating swelling be formed in the skin and subcutaneous tissue, and if the circulation in the part be not interfered with, the blood has escaped from torn vessels in such a manner as to form a blood tumour or *hæmatoma*. Two forms of hæmatomata are met with, the *circumscribed* and the *diffuse*. In the former the swelling is circumscribed and tense; in the latter the swelling is much less tense and involves a larger area, and is due to the detachment of the skin from the deep fascia with effusion of blood between them; in such a case the blood can be pressed from one part of the injured region to another. Thus, the author treated a case in which the whole scalp was separated from the pericranium without any wound; blood was effused between these structures, and when the man lay on his back it all collected in a soft loose swelling at the back, but could be easily pressed forwards on to the forehead, or laterally as far as the attachment of the scalp. Hæmatoma is generally combined with a certain amount of superficial bruising. The collection of blood may long *remain fluid*, or it may *coagulate*, and the presence or absence of fluctuation will determine this point; occasionally such a swelling *suppurates*, or, more strictly, the tissues around it become inflamed and suppurate. This has to be distinguished from simple inflammatory œdema following the tissue laceration, and is recognised (α) by increased and progressive swelling; (β) by surrounding œdema; (γ) by great heat and redness of the part; (δ) by severe pain of a throbbing character;

(ϵ) by pyrexia of a suppurative form, the temperature curve rising and falling daily ; sometimes there are chills or even a rigor, and sweating.

(*c*) The presence over a bruised part of superficial blebs containing serum, which is usually stained deep red or brown in colour, is an important sign of fracture of a subjacent bone. These blebs are often extensive, and to the uninitiated have a threatening look ; they do not really add materially to the gravity of a case. They must be distinguished from the blebs caused by burns, in which the clear serum quickly coagulates, and from those of gangrene, which are accompanied by other signs of tissue-death.

2. **Next examine the bone or bones of the injured part.**

This should be done systematically and carefully. First *compare it with the uninjured part*, and look if there is any obvious deformity ; if there is, ascertain that the two limbs or parts were symmetrical before the injury. Next measure the length of the two opposite bones, being careful to take exactly the same points on the two sides, and to place the uninjured limb in the position assumed by the injured one. It has been shown that perfect symmetry in the limbs is not so general as was formerly believed ; and useful as is the detection of a difference in length between the two limbs, this sign alone must not be taken to prove the existence of a fracture or dislocation. Then run the fingers along the most superficial surface of the bone on the two sides (*a*) to compare the outline of the bones, and (*b*) to observe whether there be any very tender point in the injured bone ; a fracture may cause so much displacement that the break in the line of the bone as compared with the sound side is at once apparent, as in the case of the common fracture of the clavicle ; on the other hand, there may be no displacement at all. The line of a fracture is generally the seat of *pain and acute tenderness*, and the detection of a spot in a bone that is acutely sensitive is strong presumptive evidence of a fracture in that situation, but it may be due to a bruise of the periosteum. Lastly, *examine for mobility* in the length of the bone; in so doing grasp the limb firmly with one hand close above, and with the other close below the supposed seat of the lesion, and first very gently attempt to move one hand independently of the other; if any movement or crepitus is detected, it is enough, but if not, then more force may gradually be used, and the whole length of the bone explored, until it is ascertained that no part of it is movable on the rest. In different cases reliance is chiefly placed upon one or other of these signs of fracture, as will be pointed out in the diagnosis of individual fractures.

THE INJURIES OF BONE ARE:

Bruise.	
Fissured fracture	simple
Incomplete fracture	compound
Impacted fracture	comminuted
Complete fracture	multiple.
Separation of epiphysis.	

If there be severe pain and marked local tenderness in a part of a bone that has received a direct injury, and if there be no alteration in the axis of the bone, no irregularity in the outline of the bone, no shortening, no mobility in its length, no crepitus, it is a *bruise of the periosteum and bone*, or a *fissured fracture*. The distinction between these conditions is a matter of great difficulty; but the more diffused and dull the pain the greater the probability of its being only a *bruise;* the more severe, and the more precisely localised the pain and tenderness, and the longer these severe symptoms last, the greater the probability of its being a *fissure of bone.* (*See also* page 228.)

If in a child, after an injury a bone be found bent and the direct distance between its two ends shortened, but there be no mobility at the bend, and no crepitus, it is an *incomplete fracture*, or *greenstick fracture.* This is most common in the forearm and the clavicle, but is seen in other long bones; it must be distinguished from a rickety curve in the bone, which is chronic, gradually produced, and symmetrical. Rickets and incomplete fractures may be associated together.

When, as the immediate result of direct violence to a bone, there is found to be some alteration in its contour and length, but no mobility at the seat of the supposed fracture and no crepitus, it is an *impacted fracture.* It is distinguished from incomplete fracture by the age of the patient and the deformity (when this can be clearly made out) not being a round curve in the bone. The lower end of the radius and the upper end of the femur are the most frequent seats of impacted fracture, and the means of exactly distinguishing these injuries are detailed elsewhere.

Where there is found mobility in the length of a bone, a *complete fracture* has been sustained; the examination of such a case also shows some or all of the following signs: alteration in length, if there be overriding or separation of the fragments; alteration of the contour of the bone at the seat of fracture, if there be any displacement of the fragments; rough crepitus on movement, if these fragments are in contact; localised pain and tenderness at the seat of fracture, at once greatly increased by any movement of the fragments; and swelling. As bones are very vascular structures, their fracture is followed by a good deal of hæmorrhage, and in a few hours this is succeeded by a free serous exudation. These facts explain the occurrence of the blebs mentioned above. In many cases the patient hears the sharp snap of the breaking bone at the time of the injury. If there is no wound of the soft parts associated with the fracture, or if there is a wound which does not lead down to the fracture, it is a *simple fracture;* but if, on the other hand, there is a wound leading down to the fracture, whether it be through the skin or mucous membrane, it is a *compound fracture.* (*See* Wound of bone, page 43.) The *direction of the fracture* may be recognised by the deformity present, and by noticing the plane in which mobility is obtained. If mobility is obtained with great ease, and is accompanied with marked and readily-elicited crepitus, suspect a *comminuted fracture;* and if manipulation shows that the bone is broken into more than two fragments (if, for instance, other fragments are felt separate from and movable upon the two main ones), this suspicion is converted into a certainty. If, however, the fragments are broken off by distinct fractures, it is called a *double fracture;* this accident is rare except at the lower end of the femur and humerus. Comminution is generally easily detected in compound fractures when the fragments can be felt, but is often overlooked in simple fractures, especially when small splinters or fragments are detached from the deep aspect of the bones. When a sharp-pointed fragment, not including the whole thickness of a bone, is detached, it is spoken of as a *splintered fracture.*

If a fracture occur in the position and direction of the junction of an epiphysis with a diaphysis, in a person under twenty years of age, and if the crepitus be softer and less distinct than in a common fracture, and the projecting points of the fragments be smooth and rounded, or at least less sharp and angular than in ordinary fractures, it is a *diastasis* or *separation of an epiphysis.* This is most commonly seen at the lower end of the radius and femur, and the upper or lower end of the humerus. It is a grave injury, as it is liable to arrest permanently the growth of the bone.

3. Then examine carefully into the condition of the joint or joints.

This examination should be systematic, and should determine (*a*) whether there is any displacement of the articular ends of one or other bone, and if so, to what extent; (*b*) whether there is any fracture of either bone at the joint; (*c*) whether there is any laceration of ligaments, or (*d*) effusion into the joint.

(*a*) Compare carefully the same joints of the two sides of the body and determine whether the articulating bones retain their normal relative position; any modification of this is a *dislocation*, which may be *complete* or *incomplete*. The two signs of dislocation which are unmistakable are the absence of an articular end of bone from its normal situation, and its presence in an abnormal position; and the student must not forget that the diagnosis should be made to rest upon these phenomena, and not upon mere alterations in contour and measurement, which, although depending directly upon the displacement, may yet be simulated by other conditions. For example, finding the glenoid cavity empty, and the head of the humerus resting on the ribs just below the coracoid process, are absolute signs of a subcoracoid dislocation of the shoulder, and are of more value than a number of such observations as "flattening of the shoulder," "alteration of the axis of the arm," certain limitations of movement, and so on. These indirect evidences of dislocation are by no means unimportant, and it is not intended to disparage them, but, in view of the number of the indirect signs given by some authors, and the stress laid upon them, it is necessary to insist upon the primary importance and value of the two great essential signs of dislocation. For purposes of diagnosis, what I have called the "essential" signs of dislocation are alone sufficient, and it is only where, from special conditions, they cannot be clearly and directly elicited, that their indirect evidences have to be relied upon.

(*b*) The mode of investigating, and the signs of a *fracture* of the articular ends of bones, are those which have been already given in the previous section, and it is only necessary to add the special and characteristic features of *fractures into joints*, by which they may be distinguished from *fractures near joints;* these are (α) the position of the fracture, *e.g.* all complete transverse fractures of the patella must be into the knee joint; (β) the size and shape of the detached fragment: by this we can determine whether there is an extra-articular fracture of the internal condyle of the humerus, or whether the trochlear surface is broken off; or similarly, finding that an entire condyle is movable on the rest of the femur demonstrates a fracture into the knee joint; (γ) effusion of blood into the neighbouring joint, recognised by the position and shape of the swelling, and by its appearance quickly after the injury: this sign is somewhat equivocal, as the extra-articular swelling may conceal that within the joint, and the joint may be swelled independently of the fracture extending into it; (δ) subsequently, inflammation of the joint; (ε) the nature of the fracture; some fractures are frequently complicated with fissures reaching into the adjacent joint, as *e.g.* those of the lower end of the humerus; and in wounds of bones from conical bullets extensive fissuring frequently occurs; (ϛ) in compound fracture synovia may be seen to escape from the wound.

(*c*) If, after a sudden wrench or strain to a joint, it becomes swelled and painful, and movement is limited and very painful, while examination shows that there is neither fracture nor dislocation of the bones, nor rupture, nor displacement of muscles and tendons, it is a *sprain of the joint.* These sprains vary much in their intensity. If there be an unnatural degree of mobility in a joint, as of lateral motion in the knee joint, it indicates *rupture of the ligament* normally limiting that movement; if, on the other hand, without this unnatural extent of movement, a particular movement causes acute pain, it indicates a *stretching and partial laceration of the ligament* that is put on the stretch by the movement in question. When, however, slight movements, not extensive enough to stretch any ligaments, elicit sharp pain, and when there is effusion into the synovial cavity, as shown by a fluid swelling having the outline of that cavity, it indicates that the chief stress of the injury has been upon the synovial membrane, and that it is to be regarded rather as a *bruise and laceration of the synovial membrane.* These lesions are variously combined in different cases, and it is often impossible to arrive at an exact diagnosis of the injury sustained; but in all cases great care should be taken to determine that there is no displacement of any of the structures entering into or immediately surrounding the joint,—bones, interarticular cartilage, or tendons.

4. **Examine the muscles and tendons of the injured region.**—The injuries these structures may sustain are:

(*a*) Bruise of muscle.
(*b*) Rupture of muscle.
(*c*) Rupture of tendon.
(*d*) Displacement of tendon.

(*a*) When, after a blow, strain, or prolonged and violent contraction, a muscle is found somewhat swelled, tender to pressure, with a sense of stiffness and weakness, and acute pain is produced on attempting to put it into action, the injury is a *bruise* or *strain of a muscle;* when produced by a blow it is called a *bruise* or *contusion,* and when caused by over use it is called a *strain*. This injury is most common in the deltoid, pectoralis major, biceps, pronator radii teres (lawn-tennis arm), adductor muscles of the thigh (rider's sprain), hamstrings, muscles of the calf, and the extensors of the spine.

(*b*) When, during some sudden and powerful contraction of muscle, there is experienced a sudden and sometimes very severe pain, followed by a notable sense of weakness, and on examination there is found a more or less marked gap in a muscle, with swelling from effused blood, a *rupture of a muscle* has occurred. Its production may be attended with an audible snap, and attempts to put the muscle into use are painful and futile. Subsequently the two ends of the ruptured muscle remain widely separated.

(*c*) When, with symptoms exactly like those attending a rupture of a muscle (sudden pain and an audible snap, with sudden loss of power), there is not found any gap in a muscle or swelling over its fleshy part, unless it be some fulness produced by its retraction, and yet it is impossible to make its tendon tense or produce its particular movement; or if a distinct gap can be felt in the tendon, as in the case of rupture of the tendo Achillis, *rupture of a tendon* may be diagnosed.

(*d*) When, as the result of some sudden strain or wrench, there is acute pain, with tenderness in the course of a tendon, swelling and ecchymosis, and contraction of one or other of the muscles of the part excites severe pain, while its tendon is found not to occupy its normal position, a *dislocation of a tendon* has occurred. This is most frequently seen at the ankle, in connection with the peroneus longus tendon, which starts forwards over the malleolus, or at the knee, where the patella with its tendon is displaced on to the outer side of the joint, or one or other hamstring tendon is displaced. It is said also to be frequent in connection with the long tendon of the biceps, causing the arm to be locked in the abducted position until set free by flexion of the shoulder and rotation of the limb. When this injury is of old standing it is more easy of diagnosis, as there is no swelling and ecchymosis to conceal the displaced tendon.

5. **Examine carefully the condition of the vessels of the part.**—Compare on the two sides the pulse in the arteries beyond or at the seat of the lesion, note the temperature of the part, and by compression of a superficial vein determine the freedom and rapidity of the venous circulation.

(*a*) If there be no pulsation in the arteries below an injured part, and the limb become pale and cold, while the pulse in the superficial arteries of other parts of the body be plainly felt, and the colour and temperature of the injured part be normal, and there be no notable swelling or displacement of a bone compressing an artery, it is a case of *partial laceration of an artery, with occlusion*, the torn inner and middle coats, together with blood clots, having blocked up the lumen of the vessel. In such a case it may be possible to trace the pulse down to the seat of the injury, and there note its sudden disappearance.

(*b*) Where, with similar symptoms, there is a fracture or dislocation, and the reduction of the displaced bone is followed by a return of pulse in the arteries below, the injury has evidently been *compression of the artery.*

(*c*) Where, immediately after an injury, a fluid swelling is very rapidly developed, with œdema of the parts below, and impeded circulation, there has evidently been a *rupture of a large vessel.* If the arteries beyond the injury are quite pulseless, and the part notably cold, the swelling tense, with or without expansile pulsation, thrill and bruit, it is a *ruptured artery;* it must be remembered that when the rupture of the vessel is complete, and there is no form of sac around the effused blood, there is no pulsation and no thrill. Where, on the other hand, there is a pulse in the arteries beyond the swelling, and the part is not notably cold, while the tumour is without pulsation, bruit, or thrill, a *ruptured vein* may be diagnosed.

(*d*) Where at some interval after an injury pulsation is suddenly found to be lost in an artery, the vessel at this part feeling solid and firm, the parts beyond being at first pale, cold, and pulseless, although they may subsequently recover, there has been a *secondary occlusion of the artery*, and where embolism may be with certainty excluded, owing to the absence of any source of an embolon, *arterial thrombosis from contusion or inflammation* may be diagnosed.

(*e*) Where at some interval after an injury a vein is found to be occluded, forming a solid, round, firm cord, the veins opening into which are distended, *thrombosis of a vein from contusion* may be diagnosed. This must be distinguished from thrombosis due to a general enfeeblement of the circulation, which is characterised by its wide extent. (*See* page 347.)

6. **Examine the nerves of the injured part.**—Nerves may be *contused*, *lacerated*, or *compressed* by subcutaneous injuries, and later on may be *inflamed*, or become the seat of *tumours*. The history of the case will determine whether the lesion be contusion from a direct blow, laceration from over-stretching, or compression from the displacement of a bone, the formation of callus, or the extensive effusion of blood or other fluid. Where the injury is due to contusion, laceration, or displacement of a bone, as in a dislocation, the symptoms come on at once; but where they are dependent upon the pressure of effused blood, or of an abscess, or to the implication of a nerve in callus, they come on later, at a time corresponding to the occurrence of these phenomena. Where there

is any reason to suspect an injury to a nerve, the surgeon should carefully test the patient's power of contracting all his muscles, and the acuteness of the sensibility of the skin, comparing together the sound and the injured limbs. By noting the intensity of the paralysis, and of the anæsthesia or paræsthesia, the intensity of the lesion may be judged of, while the exact distribution of the motor and sensory paralytic phenomena will indicate the nerve or nerves that are involved. As already hinted, the symptoms vary with the intensity of the nerve lesions. But it is to be noted that motor paralysis is more frequent and more marked than are changes in sensibility.

When, after an injury, there is found to be weakness or paralysis of certain muscles, which are not themselves injured, and, in addition, there is numbness or insensibility of a certain area or areas of skin, with a sense of tingling, formication, and weakness, there is an injury of the nerve or nerves supplying the affected muscles and skin. Later on the affected muscles waste, and the skin and other tissues may undergo the changes to be mentioned in reference to wounds of nerves. (*See* page 42.)

Subcutaneous injuries of viscera are considered in the chapters devoted to the diagnosis of the various regions of the trunk.

CHAPTER III.

GENERAL DIAGNOSIS OF WOUNDS.

In this chapter will be considered the signs by which we are able to determine the nature of a wound, the parts that have been injured and the subsequent progress of the lesion. It will be convenient to take these points one by one.

A. **The nature of a wound,** by which is meant the kind of injury which has been inflicted on the tissues; the features of recent wounds only will be here spoken of.

(1) If the wound be a simple clean cut through the skin or other tissues, bleeding freely from its whole surface, the appearance of the skin quite up to the edge of the wound being unaltered, and the surface of the cut being smooth, showing the different structures cut through, it is an *incised wound.*

(2) If the wound have been inflicted with some blunt instrument, do not bleed freely from the whole surface, the skin for a varying distance from the cut-edge being livid, ecchymosed, more or less cold and numb, and the cut surface dark in colour and uneven, it is a *contused wound.*

(3) If the surface of the wound be extremely irregular, with long shreds of tissue adherent to it, with very little hæmorrhage, or none at all, it is a *lacerated wound.*

Contusion and laceration are often combined, and the wound is then spoken of as a *contused lacerated wound.* Incised wounds are much the most painful, the pain being of a sharp stinging or burning character; in contused and in lacerated wounds, the pain, much less severe, is of a dull, aching, or benumbing character.

(4) The shape and superficial extent of wounds may vary within the widest limits; but only two varieties require notice here, and one is where a distinct flap of tissue has been cut or stripped up. Such a wound is to be called a *flap wound,* "incised" or "lacerated" being added as a prefix, according to circumstances. The other is where the depth of a wound is out of all proportion to its superficial extent, a *punctured wound*;

and as these may be inflicted with sharp, clean-cutting instruments, such as daggers and bayonets, or with blunt weapons, such as bullets, they may have the characters either of incised or of contused wounds, and this fact should be expressed by a prefix.

(5) In case of contused and torn wounds it is important to determine whether the tissues have been *injured beyond all recovery.* If, after the patient has recovered from the primary shock, and the general circulation is re-established, there be no signs of circulation in the part, if compression make no alteration in its colour, and if it remain cold and quite senseless, it may be decided that the part is actually dead; but these signs must be unequivocal before such a diagnosis is to be made; where they are not thus plain, time will soon show whether the tissues retain their vitality or not.

(6) If the local or the constitutional effects of a wound are not explicable upon the extent and severity of the wound, it is a *poisoned wound.* The particular symptoms vary of course with the poison; in one case it may be coma from morphia; in another, tetanic convulsions from strychnia; in a third, paralysis from curare; in a fourth, septicæmia; in a fifth, local suppuration with lymphatic inflammation; in a sixth, convulsions from hydrophobia; in a seventh, local induration and the constitutional effects of syphilitic infection.

B. **The parts injured.**

(1) Injury to the *skin* or *mucous membrane*, as the case may be, is obvious; if the wound extend through the *whole thickness of the skin*, it gapes, and allows the subcutaneous fat to be seen. If muscular tissue, known by its deep red colour, or tendons (glistening white bands) are seen in the wound, the *deep fascia* has been divided. A cut into *muscle* is also obvious. *Complete division of a tendon* is determined by noticing

(*a*) that the patient is unable to execute the particular movement accomplished by the muscle in question; (*b*) that he is unable to make the tendon tense; (*c*) in some cases, that the retracted muscle makes a distinct swelling; (*d*) and sometimes that the divided tendon, one or both ends, can be plainly seen in the wound, the proximal end being drawn upon when the patient puts the muscle in action.

(2) If there be an oozing of bright blood from the whole surface of the wound it is *capillary hæmorrhage.*

(3) If, in addition to this, there be a rapid continuous flow of dark blood from one or more points of the wounded surface, it is *venous hæmorrhage.* Venous hæmorrhage is not attended with local blanching, nor with interference of the pulse in the arteries beyond, when compared with those of the opposite side; it is lessened or stopped by moderate pressure on the distal side of the wound, and increased by moderate pressure on the cardiac side; firm pressure on the cardiac side, by stopping the arterial flow to the part, of course stops, but not instantly, loss from a wounded vein. If a large vein be opened, such as the axillary or jugular, the blood may spurt from the wound, but the flow, however rapid, is continuous.

(4) If, at the same time that a vein is wounded, a sucking or hissing sound be heard, and the blood be noticed to be frothy, *air has entered the vein.* This only takes place through the veins close to the heart, especially the innominates, jugulars, and subclavians; if the air enter in any quantity it produces sudden death or severe symptoms of cardiac failure, *i.e.* pallor, dyspnœa, very rapid weak pulse.

(5) If there be a rapid flow of bright red blood from a particular spot in the wound, the blood being forced out in a jet and *per saltum,* it is bleeding from a wounded artery, *arterial hæmorrhage.* If the

patient be inhaling ether or nitrous oxide gas, the blood even from an artery will be dark in colour, but will be readily distinguished from that coming from a vein by its remittent flow. Arterial hæmorrhage may, however, lose this character under two circumstances: (*a*) if the blood do not escape directly from the artery, but flow along a more or less narrow or sinuous wound, its jetting flow is lost, and (*b*) in the case of small arteries, where, from loss of blood or from obstruction in the flow above, the arterial tension is considerably lowered, the flow may become continuous; it is, however, distinguished then from capillary oozing by its escape from definite spots in the wound, and from venous hæmorrhage by its colour, its control by pressure above, and the failure of distal pressure to stop it. Where a large artery is wounded, such as the carotid, femoral, or axillary, the blood issues with a distinct hissing noise. In the case of an artery wounded in its continuity, it may be possible to determine what vessel is injured by noticing (*a*) if there be blanching of any part, as *e.g.* of the sole of the foot in division of the posterior tibial artery during tenotomy; (*b*) loss of pulse in the artery beyond; thus, if with a wounded artery at the root of the neck, the pulse in the carotid or facial artery and the brachial or radial is unaffected, it proves that neither the carotid nor subclavian artery is the one injured; similarly, in the case of a stab in the thigh, if the pulse in the tibial arteries is equal in the two sides, it shows that the femoral trunk is not wounded. In many cases the position of the wound is enough to determine what artery is wounded; but in many others it is uncertain until the bleeding vessel is actually found, and its exact relations to surrounding structures are seen.

(6) The division of nerve trunks is best shown by the anæsthesia of parts beyond the wound, and also

by paralysis, but care must be taken to exclude the direct effects of the wounds of muscles when estimating the latter. In such a case as the division of the great sciatic nerve in the buttock, the palsy of the muscles of the toes (quite at a distance from the injury) is very characteristic. A divided or partially divided nerve may be visible in a wound.

(7) Complete division of a bone in a wound is evidenced by the usual signs of *fracture*, *i.e.* mobility in the length of a bone, crepitus, irregularity of the outline of the bone, and one of the fragments may be visible; but where a bone has been only partially severed, a so-called *wound of bone*, the fact can only be detected either by the eye, or by the finger or probe feeling the cut in the bone, while the signs of complete fracture are absent. The association of a fracture of a bone with a wound of the soft parts is a very important one, for if the latter extend down to the broken bone it forms a *compound fracture*. To determine whether this is the case is usually quite easy, as one or other fragment may protrude from the wound, or be visible in it, or the finger introduced into the wound may at once detect the fracture. In other cases it is equally apparent that the wound is quite superficial, perhaps a mere abrasion, or at some distance from the fracture, the latter not being "compound." In a third series of cases the student may be in doubt, and then the amount of hæmorrhage from the wound will be the best indication; bone is a very vascular tissue, and if from a small wound, over and complicating a fracture, there be a free trickle of bright blood continuing for some hours, it is very strong evidence of the fracture being compound; a probe may be carefully introduced to detect the bone, but great care should be used lest the wound be deepened or hæmorrhage renewed.

(8) If a clear tenacious fluid be seen to flow from a wound, either pure or mixed with the blood, which

can be drawn out into "strings," *a synovial cavity has been opened.* If the wound be immediately over a bursa or synovial sheath, and the fluid small in amount, and especially if a tendon be exposed in the wound, it may be diagnosed as a *wound of a bursa, or synovial sheath;* but if the wound be directly over a joint, and the quantity of fluid be more than a drop or two, it is probably a *wound of the joint.* In extensive wounds there is no difficulty in determining whether a joint is injured or not, as the articular surfaces may be exposed, or may project, or portions of articular cartilage may be chipped off and be found free in the wound. It is in the case of small punctured and incised wounds that the difficulty arises. In no case must a probe or any similar instrument be passed into a wound over a joint to determine its depth, as it may actually tear the synovial membrane, and inflict the injury most of all to be avoided. Whenever there is doubt, the case must be treated as a wounded joint, and if the part swell out with effusion into its articular cavity, the diagnosis of a wounded joint may be considered to be established; similarly, where a bursa becomes distended, evidence is afforded of a wound extending into it. The exact position and direction of a wound, together with the amount of synovia escaping, are the best guides in deciding between a wound of a bursa and a wound of a joint.

(9) **Wound of a serous cavity** is only certainly determined by the protrusion of one or other of the contained viscera. A few drops of serous fluid may be seen to escape, but only in the cases where the wound is so small and clean-cut that this cannot have been expressed from a clot of blood will this aid in the diagnosis; where a dropsical accumulation has been opened the amount of the flow may be decisive. Here, again, any attempt to explore the wound to determine its depth is to be earnestly

deprecated, as liable to do great mischief; and in doubtful cases, which are to be treated as injuries of the serous membranes, subsequent inflammation of the membrane confirms the diagnosis of such a wound. In the belly the *omentum* is the viscus that most often protrudes, and it must be distinguished from the subcutaneous or the subperitoneal fat by its peculiar granular appearance and feel, its distinct circumscription, and in some cases its reducibility; or it may be irreducible and strangulated, when its livid colour will be very distinctive; next to it the *small intestine* most often protrudes. In the scrotum, the smooth, glistening *testicles* may protrude. Injury of the serous cavity of the head is in some cases characterised by a continuous flow of the cerebro-spinal fluid, and occasionally by a peculiar symptom, viz. a spurting forth of the cerebro-spinal fluid when the jugular veins are compressed. (*See* page 83.) Wound of the pleura without wound of lung only rarely occurs, and is extremely difficult of diagnosis unless there be prolapse of unwounded lung. (*See* page 136.)

(10) The diagnosis of **wounds of viscera** is considered in the chapters devoted to local injuries, as it is impossible to generalise with any advantage the symptoms caused by injuries to the various viscera.

(11) The diagnosis of **wounds of the ducts of glands** rests upon the position of the wounds and the flow from them of characteristic secretion (such as saliva or milk or urine). (*See* chapters on Local injuries.)

C. **The subsequent progress.**—The constitutional complications attending wounds are considered in chapter iv., and therefore only the local phenomena attending their healing, and their local complications, will now be dealt with.

(1) A wound may be found not to undergo any change whatever, even for many days after its infliction; a little dark blood oozes from it, but the natural appearance of the severed tissues is in no way obscured, and there is no union between adjacent surfaces. This *delayed healing* is only occasionally seen, and arises from severe constitutional debility. As a late symptom, delay in healing, or even the breaking down of union already accomplished, may attend erysipelas, pyæmia, and some other severe constitutional affections.

(2) If it is found that the cut surfaces are in apposition and adhering together by a soft, yellowish material, that there is no purulent discharge, and at the most a thin scab of dried blood or of soft yellowish lymph over the wound; that there is no (or very trifling) redness and swelling about the edges of the wound; that there is no pain, and only slight tenderness, such wound is healing by *first intention.*

(3) If the edges of a wound are found adhering as above described, or have been united by the surgeon, but the skin around shows a blush of redness, sometimes slight and at others deep, with marked swelling and even superficial œdema, and there be severe pricking, stabbing, or throbbing pain, considerable tenderness, with fever, the temperature perhaps ranging as high as 104°, and accompanied with a chill, there is *retained discharge*, a condition of tension; this, if unrelieved, will quickly run on to *abscess*, which will then burst through the softly united edges of the wound, or through the skin, and if the wound be not aseptic may lead to septic poisoning. The retained fluid may be blood or serum, the former accumulating within the first few hours after the dressing of the wound, the latter within the first two days, as a rule.

(4) If the cut surfaces do not directly adhere, but the tissues composing them become obscured by a

translucent layer of coagulated lymph, this state is called the *glazing* of a wound. The lymph becomes opaque, then pink, then florid and uneven on the surface, from the formation of minute conical elevations, and these gradually grow towards the surface, their growth being attended with the secretion of laudable pus, the wound healing, it is said, by *granulation,* or *second intention.*

(5) If opposing granulating surfaces become directly adherent in place of the cavity between them being filled up by the growth of granulating surfaces, it is called healing by *third intention.* This is known by the sudden diminution of the pus secreted, and by direct observation of the union. The diseases of granulating wounds are considered in the chapter on *Ulcers.*

(6) If a wound be wholly or in part filled up with a blood clot, and this clot do not soften and flow away, but remain firm and fixed; and if after several days a thin dry layer of it separate and show a soft delicate cicatrix below, it is called *organisation of, or more correctly in a blood clot.* This is the process which has long been familiar in small wounds as *healing under a scab.* In clots of larger extent, only the deeper part of the coagulum may become organised, the upper part breaking down.

(7) **For gangrene** occurring in a wound *see* page 345; and for *erysipelas, septicæmia and pyæmia, see* pages 65 *et seq.*

(8) Bleeding recurring from a wound during reaction, *i.e.* within forty-eight hours of its infliction (most common within the first eighteen hours) is called *intermediary or recurrent hæmorrhage.* But if the bleeding occur later than this, it is *secondary hæmorrhage.* If, while dressing a wound, a little trickle of bright blood be seen to come from the deeper parts of the wound, and if this be not caused by any

movement or manipulation of the wound breaking down some granulations, and especially if it recur spontaneously, it is probably the forerunner of an extensive secondary hæmorrhage.

(9) If with acute febrile symptoms with or without an initial rigor, the parts about a wound implicating a bone are found much swelled, and the soft parts, including the periosteum, retracted, leaving the bone dry and bare; and if in a case of amputation a soft fungous mass protrude from the end of the medullary canal, and the probe passed into this meet with no resistance and possibly liberates some pus, *acute osteomyelitis* is present.

(10) If after the healing of a wound a part below continue insensitive and cold, and especially if its muscles are paralysed and wasted, with loss of irritability to the faradaic current, it indicates that a severed nerve has not united. This has to be distinguished from the immobility of a part from division of a tendon or a muscle. The *position of the scar* (in the one case over a nerve, and in the other over a muscle or tendon); the *extent of the paralysis* (in the one case affecting all the muscles supplied by the nerve below the scar, in the other affecting only the muscles wounded); and the *accompanying electric and sensory phenomena* are sufficient to establish the diagnosis.

If the skin of the affected part be rough and covered with dry, scaly epidermis, the *nerve or nerves are completely divided.* In cases where the skin is smooth, glossy, devoid of hair, with patches of livid red colour, or herpetic eruption, smart burning pain, and the muscles have wasted rapidly, there has been *incomplete division of the nerve.*

(11) If a scar remain painful and tender, the condition is spoken of as *neuralgia of cicatrix.* Of this it is necessary to distinguish two varieties. Where the pain is localised, and is especially excited by pressure

on a particular spot, the neuralgia may be considered to be of *local origin*, and this diagnosis will be confirmed if there be an induration, or adhesion of the scar to a bone at the tender spot. If, on the other hand, the pain is more widely diffused, and especially if it be attended with marked superficial hyperæsthesia, be intermittent in character or attended with spasmodic jerkings of the part, and if the patient be anæmic, or subject to neuralgia in other situations, the disease may be diagnosed as of *constitutional origin;* the latter form is more common in women.

(12) When a cicatrix enlarges, becoming thicker, prominent on the surface, wider, remaining firm, smooth and of a delicate pink or purplish colour, it is called a *keloid scar*. This disease may attack a scar at any time after its formation, and after a certain advance may remain stationary, or the growth may be absorbed. It may attack a large scar in several situations. Its smoothness, firmness, slow growth, and its not ulcerating, together with its spontaneous recession or disappearance, distinguish this disease from epithelioma attacking a scar. (*See* pages 286, 337.)

CHAPTER IV.

THE DIAGNOSIS OF THE CONSTITUTIONAL EFFECTS AND COMPLICATIONS OF INJURIES AND OPERATIONS.

It is extremely important to recognise with as much accuracy as possible the constitutional condition of patients suffering from injuries or surgical diseases. The importance of and the interest attaching to the diagnosis and treatment of local surgical maladies may tend to concentrate the attention too exclusively upon local conditions at the expense of neglect of the constitutional. Such tendencies should be carefully resisted. The constitutional effects of local surgical conditions vary from the most trivial to the most severe, and this makes it impossible to do more than discuss the diagnosis of certain typical forms; but if the student will notice carefully the steps in the diagnosis of these chosen types, and grasp the meaning or the explanation of the different symptoms of constitutional disturbance, he will be able to appreciate the significance of combinations or degrees of these symptoms other than are here mentioned. Here, as elsewhere in diagnosis, it is important not to rest content with learning that a certain group of symptoms characterises a certain injury, or disease, or constitutional condition; but the surgeon must go beyond, and arrive at the meaning or the cause of each symptom, and understand *why* a certain conjunction of symptoms must indicate a certain morbid state. It is impossible in the space at our disposal to discuss in any detail those symptoms upon which the diagnosis of systemic conditions depends, the temperature, the pulse, respiration, state of digestion, general nutrition, and the various manifestations of the functions of the nervous centres. Such discussions are found in works on physiology and to some extent in works on medicine, and to these I must refer my readers, and must content myself here with the following brief notes.

Fever, by which is meant pyrexia, or increase of body-temperature, is produced (*a*) by the absorption of the products of inflammation, inflammatory fever; (*b*) by the introduction of special substances into the blood, as in so-called "septic intoxication," the infective septic fevers and malaria; (*c*) perhaps by the abstraction of certain materials from the blood, as in hectic fever; (*d*) possibly as a reflex effect of the irritation upon nerve terminals: in this way some explain the pyrexia attending tension in a wound, but a better illustration is the fever sometimes caused by a tight stitch; (*e*) possibly also as a reaction from the depression caused by the shock of an injury or operation; in this way may be explained the initial transient rise of temperature after all operations or injuries of any moment, the fever which alone should be designated "traumatic," as signifying its dependence upon the injury, and nothing else. It must be borne in mind that the intensity of a fever depends partly upon the intensity of its cause, as *e.g.* the dose of poison absorbed, and partly upon the constitutional peculiarity of the patient. As a rule, children respond more readily than adults to all causes of fever, and some adults present what, for want of more exact knowledge, can only be called an "idiosyncrasy," which makes them peculiarly intolerant of all causes of febrile excitement. The author recently had under his care a lady on whom he operated for anal fistula, in whom emotional disturbance (a fit of crying) was on several occasions found to raise the temperature several degrees. In the same manner the type of the fever is modified by the nature of the exciting cause, and occasionally also by constitutional peculiarity; as an example of the former may be mentioned the asthenic type of septic fevers, and of the latter the influence of previous malaria upon subsequent febrile attacks. In the study of fever attention should be directed to its *mode of onset*, whether gradual or sudden, attended with marked pyrexial phenomena, such as rigors, headache, etc.; the *exact time* of its onset in relation to other morbid symptoms; its *course*, duration, the height of the temperature, its modifications at different times of the day, and the manner and extent to which the other vital functions of the body besides that of animal heat are interfered with.

The pulse. — The observer should note the frequency, the rhythm, and the size of the pulse-beat, together with the fulness and tension of the artery. It is well known that the rapidity of the cardiac contractions is greatly affected by mental impressions, and care must be taken to eliminate this source of error as far as possible. With this exception, the chief causes of quickening of the pulse met with by the surgeon are collapse, hæmorrhage and fever, while it is notably slower in compression of the brain. The size of the pulse, or the degree to which the artery is affected by the wave passing along it, is dependent upon the tension of the artery and the force of the heart's contraction. The tension of the artery is measured by passing the fingers across the vessel in such a manner as to feel its contour without compressing it, at the same time noting its fulness or the reverse, and also by noting what amount of compression is required to obliterate the pulse; the tension of an artery is a measure of the blood-pressure in the vessel, and as the blood pressure is very largely dependent upon the muscular tone of the vessels, its chief importance is as an indication of the latter: thus, a soft compressible pulse, such as is met with in hectic fever or in septicæmia, indicates a loss of tone in the small vessels or more or less advanced vaso-motor palsy, while the hard wiry pulse of acute peritonitis indicates spasm of the muscular walls of the arterioles and vaso-motor stimulation. In certain cases coming before surgeons the pulse has a special significance in diagnosis; thus, it may be absent in some particular vessel owing to its rupture or occlusion, or it may be smaller and later in one artery than in its fellow on the opposite side of the body, owing to an aneurismal dilatation of the trunk above. Lastly, in middle-aged and elderly persons the nutritive condition of the arteries should always be observed, whether it is tortuous, moving freely in their bed with each cardiac impulse, and presenting a perfectly smooth or irregular outline to the fingers passed over them longitudinally; the first two phenomena are signs of loss of elasticity, while the detection of irregularities in the vessels point to calcification of the middle coat in the form of calcareous rings.

Respiration.—The frequency, absolute and relative to that of the pulse, and the fulness of the respiratory movements, have the same significance for the surgeon and the physician; but the former is especially concerned to notice whether the movements of the chest are uniform on the two sides, as in the diagnosis of fractured ribs and of impaction of a foreign body in a bronchus, and whether they are both thoracic and abdominal; in peritonitis the respiration is characteristically thoracic only, while in cases of crush of the spinal cord at or just below the fifth cervical vertebra it is as characteristically abdominal only. Mention should also be made of the falling-in of the soft chest-walls of children, and of the epigastrium and suprasternal and supra-clavicular regions in adults and in children in cases where there is great obstruction to the entrance of air. In these cases, it is important to observe whether the larynx moves up and down in the throat with the exaggerated respiratory efforts. When it does, it indicates that the obstruction to the passage of air is above or in the larynx; when, on the other hand, the larynx remains fixed, it shows that the obstruction is below the larynx.

The **digestive system.**—There are no special points in connection with the digestive system to which reference need be made here; the state of the appetite and thirst, the condition of the tongue, the ease and painlessness of deglutition and of digestion, freedom from vomiting, flatulence, constipation or diarrhœa will, of course, engage the attention equally of the surgeon and the physician. Of much importance as an indication of great vital depression is a dry brown *tongue,* protruded with difficulty, and exhibiting marked fibrillar tremor, and usually accompanied with sordes on the teeth and lips. In works on medicine the student will find discussions on the causes of *vomiting* and the diagnosis of its different forms. The causes of vomiting most often met with in surgical practice are (1) the circulation in the blood of certain toxic agents, such as chloroform, morphia, and the poison of erysipelas; (2) reflex nervous irritation, as in rupture of the liver, intestinal obstruction or strangulation, peritonitis, uterine and ovarian congestion; (3) and, less often, affection of the brain, as meningitis and tumour, the vomiting occurring during the reaction from collapse should be ranged in this class.

The **urine** is an important aid in determining the state of general nutrition, as well as a valuable guide to the correct diagnosis of diseases of the urinary organs. The excretion of a small quantity of *water,* while the usual quantity, or even an excess, is taken into the body, there being also no unusual loss by other sources as the skin and the bowel, is an indication of retention of water within the body, one of the most marked effects or accompaniments of fever. Excessive excretion of water by the kidneys is similarly due either to excess in absorption of water, lessened excretion by other channels, to the excretion of sugar, to the disease called diabetes insipidus, or to a chronic disease of the excreting portions of the kidney by which increased filtration of urine is permitted. Similar modifications in the amount of *urinary solids* excreted are observed; their increase shows an excessive oxidation within the body, while their decrease may be due either to diminished oxidation, or to a lessened power of excretion by the kidneys. This subject is again referred to on page 541. For remarks on the diagnostic value of disturbances of the nervous system, see pages 87 *et seq.*

The **constitutional effects of injuries or operation** are either *immediate* or more *remote;* either *primary*, produced directly and solely by the injury, or *secondary*, both in point of time and also in the influence of causes other than the mere injury. Of the former, collapse may be taken as a type; and, of the latter, septicæmia or tetanus. Injuries may cause general disturbance by affecting seriously one or more of the great vital functions, especially those of circulation, respiration, and of the central nervous system. These are intimately interdependent; mere stoppage of the heart will abolish all the functions of the nervous system, and arrest respiration; and a lesion in the floor of the fourth ventricle will at once stop the action of both the heart and the lungs. Similarly an insufficient supply of blood to the brain will induce a feeble performance of all its functions; while any influence upon the nerve-centres reducing their activity, may enfeeble and impair the action of the heart. Hence it comes about that the final effects of severe injuries, damaging the brain or the organs of circulation or of respiration, may be closely alike.

While, however, injuries can only tell primarily upon the functions of circulation and respiration (except through the nervous system) by direct interferences with those functions, in the one case, by loss of blood or stoppage of the heart's action by pressure, laceration of its walls or incompetence of its valves; and, in the other case, by obstruction to the passage of air or arrest of respiratory movements; they can affect the nervous centres both directly and indirectly; directly, as when the brain is concussed or compressed; indirectly, by an impression made upon a nerve terminal being conducted up to the centre, and then exerting its influence, as when a crush of the great toe causes collapse or syncope. When an injury affects the nerve-centres by an impression conveyed up to them by afferent nerves, the injury is said to be attended with "*shock*" to the nervous system. *Shock* is sometimes used to designate both the ascending nervous impression and the symptoms resulting from it; it should be employed in the former sense only; and for the latter, or the effects of shock, the term "*collapse*" should be used. Shock and its consequent collapse may be caused by other conditions than injury, *e.g.* depressing mental emotions. The intensity of shock varies with the intensity of the injury, and with the part injured, that due to visceral lesions is particularly severe; while the resulting collapse varies with the intensity of the shock, and what may be termed the "stability of the nerve-centres." Children, "nervous" women, and old persons show the effects of shock more markedly than robust men, while the influence of pre-occupation or intense mental excitement or concentration in opposing the influence of shock, is instanced by the numerous accounts of severe injuries received upon battle-fields without any collapse being produced at the time. It is further to be observed that, in consequence of the rapidity of all nervous processes, the effects of shock and of direct injury to the nerve-centres, are instantaneous, although when the injury increases, as in subcranial or meningeal hæmorrhage, the symptoms vary or increase in proportion. On the other hand, the constitutional effects of direct injury to the respiratory and circulatory organs are nearly always more or less gradually induced.

Every injury produces some degree of *shock*, and the impression in every case exerts a depressing influence upon the nerve-centres. The resulting *collapse* varies from a systemic disturbance unnoticed and transient, up through all grades, to an intensity such as to cause instant death. When the constitutional symptoms are due to failure of the heart's action, and the consequent anæmia of the brain, the condition is called *syncope;* this may be produced by shock, being, indeed, one form of collapse, as when it is caused by the passage of a catheter, or by fright; or it may result from direct interference with the circulation, as from hæmorrhage and the toxic effect of chloroform. Like collapse, syncope varies between the wide extremes of brief insensibility and sudden death; when pronounced and severe it may be indistinguishable from collapse. In addition to constitutional states, primarily resulting from injuries, the association of recent injuries with conditions quite independent of them, such as apoplexy, alcoholism, and epilepsy, must be borne in mind; and it will be well, therefore, to consider the diagnosis of all these together:

Collapse.
Syncope.
Concussion of brain.
Compression of brain.
Apoplexy.
Epilepsy.
Alcoholism.

1. If a patient be pale, with blanched cheeks and lips, sunken features, dull motionless eyes, cold skin, with beads or drops of sweat on the brow or other parts, with a frequent small very compressible pulse, or even a pulse imperceptible in the radial artery, with shallow noiseless respiration, muscular relaxation, so that the limbs are flaccid and fall about under the influence of gravity, while no resistance is offered to movements at the joints, the relaxation of the sphincters being attended with involuntary escape of fæces or urine; and if there be mental apathy, which may be exaggerated up to complete unconsciousness; the condition is said to be one of *collapse.* In a typical case all the vital functions are equally depressed,

and the recovery is gradual and slow. As a variation may be mentioned a state in which, with extreme pallor, coldness, feebleness or absence of pulse and muscular relaxation, consciousness is preserved intact; this is especially, but not exclusively, observed in cases of *collapse from hæmorrhage.* In collapse from this cause it is to be noted that the circulatory phenomena precede the nervous and muscular.

2. If a patient suddenly becomes quite unconscious, with general muscular relaxation, and either sudden stoppage of the heart or great diminution in the force of its contractions, with pallor, dilated pupils, insensitiveness of the conjunctiva, weak superficial respiration, and these symptoms quickly pass off and end in recovery; or, on the other hand, if sudden death ensues from the sudden arrest of the heart's action, the condition is generally known as *syncope.* The distinctions between syncope and collapse are not absolute, and individual surgeons employ the terms somewhat differently; the main point is to discover whether the symptoms are due to a general failure of nerve force, or to a primary arrest or enfeeblement of the circulation; from true collapse there is never the sudden or rapid and complete recovery that is witnessed in some cases of syncope.

3. When a patient presents the above general symptoms, but it is observed that the mental phenomena are out of proportion to the feebleness of the circulation, there being perhaps apparent complete unconsciousness, the patient only being roused to mutter when shouted at, or severely pinched, while the pulse is plainly felt at the wrist, *concussion of the brain* is to be suspected; and if there be no signs of paralysis or convulsions, while a history of a blow on the head, or of a general shake of the body with immediate onset of the unconsciousness, can be obtained, the diagnosis is established. As will be mentioned

later on, the symptoms of concussion vary greatly in intensity, from slight vertigo up to instant death; but they are always sudden in their onset, immediately succeeding the injury causing them, and the cerebral phenomena are the most marked and the most enduring, unconsciousness often lasting for many hours after the pulse has fairly recovered. (*See also* page 91.)

4. As the diagnosis of conditions of unconsciousness associated with injury is considered separately in the chapter on injuries of the head, page 91, it is only necessary here to point out that the distinguishing features of *compression of the brain* and of *apoplexy* are the completeness of the unconsciousness and the attending paralysis; those of *epilepsy* are the occurrence of tonic succeeded by clonic convulsions.

5. **Alcoholism** to a degree short of producing unconsciousness may complicate the diagnosis of the constitutional effect of an injury. Unfortunately, its features are almost too familiar to need description, but special notice should be taken of the flushing of the face and surface generally, the unsteadiness of all muscular actions, as seen in the tremor of the tongue and the stumbling gait, and the mental inco-ordination, as seen in the incoherent talk, often foul or foolish, the inability to grasp an idea, or the obstinacy with which a false idea is held.

The surgeon must not forget the possibility of the *entrance of air into a vein*, or the occurrence of *cardiac* or *pulmonary thrombosis*, complicating an injury or an operation.

Collapse, unless fatal, after a time passes off, and is succeeded by reaction. The earliest signs of *reaction* are increased fulness and strength with lessened frequency of the pulse, sighing respiration, a return of warmth to the surface, slight voluntary movements, and vomiting. Reaction is complete when the surface is warm, and consciousness is restored and it is generally attended with restlessness, heat and dryness of skin, and abiding quickness of pulse. If, however, the patient be restless, unable to sleep, and even delirious, with hot dry skin, anxious flushed face, quick bounding or sharp compressible pulse, with weak tremulous movements, thirst and frequent vomiting, and hurried respiration, the condition is known as *prostration with excitement*. These symptoms are sometimes met with after severe hæmorrhage, and if they do not end in recovery, the pulse becomes fluttering and very quick, the skin cold and clammy, and convulsions and coma usher in death.

The **secondary constitutional effects of injuries or operations and diseases are:**

- Fever.
- Fat embolism.
- Pulmonary thrombosis.
- Delirium tremens.
- Exhaustion.
- Tetanus.
- Hydrophobia.

The existence of pyrexia, or increased body-heat, is the essential and pathognomonic sign of *fever*. This is usually accompanied by increased frequency of pulse and respiration, and disturbance of the cerebral, cutaneous, and other functions. It is not sufficient to recognise the mere existence of fever, but an attempt must be made to determine the kind and degree of the constitutional disturbance, and then from this and other facts to decide as to its cause and nature.

Fever varies very widely in different cases; it may be a mere transient pyrexia, accompanied by scarcely noticeable disturbance of function, while in other cases it may be fatal from the intensity of the body-heat or from extreme prostration. Two chief types of fever are usually described, sthenic and asthenic, and well-marked cases of either form are frequently to be recognised; but there is a large intermediate class of cases exhibiting all the marked characteristics of neither of these types, and which forms a continuous gradation between them. The student should carefully remember that in the study of fever it is most of all important to regard it as a general disturbance of vital function, and that to form a due estimate of any case it is necessary not simply to measure the rise of temperature and study the temperature curve, although that is of great value, but he must regard the patient as a whole, and estimate the kind and degree of disturbance of all the vital functions. In one case the temperature may be very high and out of proportion to the intensity of the other signs of illness, in another this due proportion will be observed; in a third the frequency and softness of the pulse will indicate that the disturbance of the circulation is greater than that of other functions; in yet a fourth case, the nervous symptoms will predominate, and so on; and it is only when a good estimate is formed of the character and amount of the general systemic disturbance that is caused, or accompanied by, fever that a diagnosis of this condition in any true sense can be said to have been arrived at. In these days, when the thermometer is used as a matter of routine, and temperature charts are carefully drawn up so that the course of the pyrexia can be seen at a glance, there is a temptation to rely too exclusively (not too much) on this one manifestation of the febrile condition, and to neglect an equally careful and painstaking examination of the others.

If with pyrexia the skin be hot and dry, the patient experiencing a "burning" sensation, and complaining of great thirst, restlessness, and frontal headache, with inability to sleep, and the face be found flushed, the eyes suffused, the pulse full, bounding, quickened to 90 or 110, the respirations proportionately increased, the tongue moist and coated with a white fur, digestive disturbance being further indicated by complete anorexia, obstinate constipation, and sometimes by nausea and vomiting, and the urine is scanty, high-coloured and deposits lithates in abundance on cooling, the case is described as one of *sthenic fever*. This form is met with in adults who were previously healthy, and accompanying acute sthenic inflammations; the temperature range is generally between 102° and 105° Fahr.; if there be delirium, it assumes the active, noisy, or violent type.

If with pyrexia the skin be pale or livid, harsh and dry, or bathed with a clammy sweat, the features sunken, the pulse frequent (120 or more) soft, perhaps dicrotous, fluttering or irregular, respiration being hurried and shallow, the tongue dry, cracked and brown on the dorsum, with sordes about the teeth and lips, the appetite entirely lost but thirst not urgent, the motions dark and fœtid, and possibly loose and frequent, with great muscular weakness, the patient lying flat on his back and slipping down in his bed with, in severe cases, muscular twitchings, subsultus tendinum, carphology, mental obscuration, or a low, muttering delirium, the case is one of *asthenic fever*, and the condition is known also as the *typhoid state*. The temperature may be high or low; the urine is less markedly "febrile" than in sthenic fever, and not unfrequently contains albumen, in the later stages, when the nervous system becomes profoundly depressed or narcotised, it may be retained in the bladder.

It is impossible to give more than a mere outline of the diagnosis of many forms of fever which have received distinctive names according to the views held in regard to their etiology. It is not certain what part "*septic*" processes play in causing surgical fevers, nor how many several kinds of "*septic*" fevers there are, nor how far they can be distinguished from one another. A few years ago "*inflammatory*" and "*suppurative*" fever were spoken of as quite distinct from *septicæmia* and *pyæmia;* but recent advances in our knowledge have suggested that all acute inflammation is "*septic,*" and that the fever resulting from it is essentially of the nature of "*septic intoxication.*" Experiments on animals, as well as clinical experience, have shown that three varieties of "*septicæmia*" may be distinguished, at any rate, theoretically; "*septic intoxication,*" "*septic infection,*" and "*embolic pyæmia,*" but clinically we may meet with two, or even all three of these combined, and, except in typical cases, it is impossible to distinguish between them in the early stages. "*Traumatic fever,*" too, is a term which is used in different senses. If used to denote any fever attending and complicating a wound, it is perfectly valueless, as it would then include such special forms of fever as hectic and pyæmia, and the most virulent forms of septicæmia. If, on the other hand, it be used to denote the fever immediately succeeding the infliction of a wound, or other injury, there is a difficulty in determining when this can be said to terminate and other forms of pyrexia commence; and yet again, "septic intoxication" may be grafted on to and overshadow this primary wound fever. It seems to be necessary, however, to retain the term, for the recent improvements in wound treatment, together with accurate clinical observations, have demonstrated that in cases of injury or operation where there is an entire absence of septic processes, as well as of all other local complications, such as inflammation, there is a transient pyrexia. This is observed in cases of simple fracture, as well as in "aseptic," well-drained wounds, and, so far as we know at present, is beyond our powers to prevent; that fever, and that fever alone, may, with justice, be called "traumatic," and it is in that sense alone that the term will be used here. Some regard this fever as due to reflex nervous disturbance, and there is much to be urged in favour of this view; but the powerful influence exerted by modern scientific local treatment upon the primary temperature rise after grave operations affords much support to the theory which attributes this, like all other wound-fevers, to the influence of material absorbed into the blood, and then acting topically upon the nerve-centres governing animal heat.

Where fever is dependent upon acute inflammation, as shown by (1) its onset subsequent to, or, at least, not before the commencement of the local mischief; (2) the proportion between the extent and intensity of the inflammation and the severity of the fever; and (3) by the subsidence of the fever immediately upon the abatement of the inflammation, the fever may be called *inflammatory fever*. But where there is fever in the absence of local cause for pyrexia, or when it precedes, or is out of proportion to local inflammation, or continues when the local mischief has subsided, it is *septic*.

Diagnosis of surgical fevers.—1. If immediately succeeding the depression of temperature and the collapse caused by the shock of an injury, the temperature be found to rise, attaining its maximum on the second evening, occasionally sooner, rarely so late as the third evening, and then gradually falling to the normal, and maintaining the normal level by the third or fifth day (rarely later), the temperature rising usually to 100°, and rarely to so high a point as 102°, the pyrexia being accompanied with slight rise in the pulse rate (to about 90 at the most), a little restlessness for the first few hours, but no marked malaise or loss of appetite, or headache, or loaded urine, or delirium, the symptoms are due to *traumatic fever*. This fever may be very slightly marked; it seems to be quite free from danger to life. In typical instances its most notable features are the slight and transient character of the fever, and the absence of apparent illness, and of the other constitutional disturbances which usually form so large a share in the picture of fever. Simple traumatic fever may have grafted on to it other forms of fever in various degrees, and hence it becomes impossible in some cases to draw a sharp and precise line between it and them. The late effects of an anæsthetic, such as vomiting and headache, may be prolonged into the period of traumatic fever.

2. If, immediately following the infliction of an extensive wound, the temperature rise to a considerable height, 103° to 105° Fahr., with great increase in the frequency, and diminution in the force, of the pulse, hurried respiration, nausea or vomiting, marked prostration even attaining to more or less unconsciousness, and especially if there be diarrhœa, with loose dark-coloured watery stools, and the urine be albuminous, the symptoms are those of *septic intoxication.* This condition is believed to be the result of the absorption into the blood of a poison which has no power of multiplication within the body; its effects vary with the quantity absorbed, and the symptoms may be much less than described above, even down to fever with quickened pulse only, while they may be so intense as to be fatal in a few hours. The absorption may be sudden, and not repeated, or may be continuous and moderate, in which case we have what may be termed a *chronic septic intoxication*, and the symptoms of this may be blended with those of septic infection or pyæmia. This poison is not absorbed by a healthy granulating surface.

3. If at about the time when traumatic fever should subside, the temperature continue high, or rise above its former level, and the pulse become frequent and rather full, and the patient be restless, with loss of appetite, a furred tongue, and there be pain in the wounded part, the *fever of tension or of inflammation*

should be suspected, and the wound should be carefully examined; if a stitch is too tight it should be cut, any pent-up discharge should be freely evacuated, and if the fever be due to either of these causes, it will at once subside; or the wounded surfaces may be found swollen and red with commencing suppuration, and, in that case, the fever may be fairly attributed to the local inflammation. *Tension* and *inflammation* in a wound are most common from the second to the seventh day of a wound; they may occur, however, at any time previous to its complete healing.

4. If a patient who is the subject of a wound be attacked with high fever, which may be ushered in by a rigor or a succession of rigors, or if a child, by a convulsion, the temperature ranging high and showing but slight variations at different times of the day, and the pulse be quickened to 120 or more, being at the same time small, compressible, often dicrotous; the surface dusky, the skin bathed in a clammy sweat; respiration hurried and laboured; the tongue furred, quickly becoming dry and brown, with sordes collecting on the lips and teeth, and sometimes with an earthy odour of the breath, and thirst, complete anorexia, constipation or fœtid diarrhœa, with urine scanty and loaded, and often containing albumen; and if there be marked nervous and muscular prostration, as shown by the posture, by subsultus tendinum and carphology, with a low muttering delirium; and if, in addition, there be seen petechiæ on the surface, or patches of dusky erythematous redness, the disease is *septic infection*. Typical cases of this are met with in puerperal fever, in the cases of severe fever quickly ensuing upon slight pricks and inoculation with the blood or other fluids of those dying from septic peritonitis, etc. The diagnosis is confirmed where there is evidence of transference of the disease from one individual to another, and by the detection of organisms in

the blood or discharges of the patient. The special features of this form of septicæmia are: (1) The *intensity of the fever*, often to a marked degree out of proportion to the severity and extent of any local inflammatory lesion; (2) the marked *ataxic phenomena*, showing some powerful and profound blood-change; (3) the *absence of the secondary foci* of suppuration and of the recurrent rigors characteristic of pyæmia; (4) in some cases the *evidence of infection*.

5. If there be a succession of severe rigors with rise of temperature to 105°, or even to 107° Fahr. during the shiver, followed by a very short hot stage, and then a drenching sweat, during which the temperature falls, reaching the normal or even lower, but at once rises to a febrile height when the sweating stage ceases, the rigors occurring at irregular intervals (thus distinguished from *ague*), and not in connection with the passage or withdrawal of urethral instruments or the act of micturition (thus distinguished from "*urethral fever*"); and if the patient become rapidly exhausted and emaciated, with a yellow tint of skin, dry coated tongue, with a mawkish sweet odour of the breath, rapid, feeble, often dicrotous pulse, quickened respiration, constipation or diarrhœa, and the passage of fœtid dark stools, and scanty, high-coloured and sometimes albuminous urine; and if with this there be found a cessation of the healing processes in the wound if any had previously been established, and especially signs of distant local suppuration, rapid, painless effusions into joints, suppuration in the planes of cellular tissue, or a pustular eruption on the skin, plugging of veins, with perhaps signs of softening and suppuration around and in the veins at places, and in some cases pleuritic friction-sounds or the signs of localised pneumonia produced by pulmonary infarcts, the case can be diagnosed as *embolic pyæmia*. It must be remembered that death may occur after only one rigor; and that in

some cases there may be all the other signs during life, and the post-mortem appearances of this disease, without the occurrence of a rigor at any time; such a case was not long ago under the author's care. Then the diagnosis must rest upon the continued high fever and the occurrence of the secondary foci of suppuration. Careful search must be made for the secondary suppurations, for their formation is remarkably free from pain.

Cases are met with where such symptoms as the above extend over a period of weeks and months, the rigors being separated by intervals of many days, with formation of abscesses at various parts of the body at long intervals. These cases, which more frequently end in recovery, are known as *chronic pyæmia*. The exact limits of this disease are very ill-defined. Pyæmia may occur independently of a wound or injury, as in cases of "*acute necrosis*" and of "*ulcerative endocarditis*."

6. If during the healing of a wound the patient suddenly has a rigor, or is sick, and has frontal headache with anorexia, malaise, quickened pulse, and abrupt rise of temperature, and on examining the wound it is found unchanged or with stoppage of the process of healing, while the neighbouring lymphatic glands are swelled and tender, and if in a few hours this is followed by a bright-red, raised, painful, and tender blush, extending from the edge of the wound with abrupt edge, quickly spreading and perhaps attended by vesication of the surface, the disease is *erysipelas*. (For *Cellulitis*, *see* page 79.)

For the diagnosis of *Urethral fever*, *see* page 555.

7. When, after a long exhausting illness, such as the late stages of syphilis with bone and visceral disease, chronic abscesses, and long-standing suppurative disease of joints or bones, it is found that the patient is steadily losing flesh and becoming increasingly anæmic, that there is a febrile exacerbation every

evening, when the skin of the hands and feet feels hot and parched to the patient, and a bright-red flush is noticed on the cheeks, which is in marked contrast to the surrounding pallor, and that in the early morning this is succeeded by a fall in temperature with profuse perspiration, and the pulse is found soft and frequent, 90 to 120, gradually becoming weaker and more frequent, while the tongue is clean and glazed, the appetite (at any rate at first) fair, but later on becoming capricious, the bowels often loose, the urine scanty and loaded, and the mind remaining quite clear, the condition is described as *hectic fever*. This is essentially a chronic fever, with symptoms of gradually increasing exhaustion. It is sometimes spoken of as consisting of three stages. While the evening exacerbations and morning sweatings are but slightly marked, and do not interfere with the patient's rest, and there is neither diarrhœa nor scanty loaded urine, and the appetite remains good, the disease is said to be in its *first stage*.

When the evening paroxysms of fever are more marked, and the sweatings succeeding them are profuse or "drenching," the pulse very soft and compressible, with marked anæmia, capricious appetite and frequent attacks of diarrhœa, and the urine is scanty and deposits urates abundantly on cooling, it is said to be in the *second stage*.

And when the weakness and exhaustion are still more marked, and in addition there is complete loss of appetite and even inability to take food, and the tongue shows aphthous sores, while the feet and ankles become œdematous, the disease has reached its *third stage*. This soon ends in unconsciousness and death from exhaustion. Patients may complain of a sense of chilliness during the febrile paroxysm, but more often they experience a disagreeable sense of heat of skin. Occasionally in the later stages the febrile paroxysms may occur twice in the twenty-four hours, and whenever the patient falls asleep he may wake up bathed in sweat.

8. When, during the course of acute inflammation with its attendant fever, a rigor or a sense of chilliness is perceived concurrently with a rise in temperature, and especially if these phenomena be repeated, and the temperature maintain a higher general level than before, but show greater diurnal variations, it indicates the formation of pus. This stage of the fever is sometimes spoken of as *suppurative fever,* which must be carefully distinguished from hectic fever, the result of prolonged suppuration. In the majority of cases of suppuration, the surgeon is able to detect the presence of pus by local phenomena; but the occasions are not rare when the diagnosis of suppuration depends entirely or mainly upon the course of the fever. (*See Abscess of breast*, page 444.) The chilliness observed may be followed by slight sweating.

Diagnosis of constitutional complications and sequelæ other than fevers.—If, in a patient suffering from injury to a bone (especially a comminuted fracture of the shaft of a long bone), after the collapse from the shock has passed off, and generally in from twenty-four hours to three days subsequently to the injury, there are sudden symptoms of dyspnœa, with rapid laboured respirations and increasing cyanosis, although auscultation shows the air to enter and leave the lungs freely, and the pulse becomes frequent, irregular, and weak, the action of the heart being found to be turbulent, and if with this there be hæmoptysis, or fat be observed floating on the surface of the urine, the diagnosis of *fat embolism* must be made. When severe, the condition passes into one of coma and ends fatally. Fat embolism, to a minor degree, which gives rise to no ed symptoms, is said to be a frequent if not a constant phenomenon in all cases of fracture. The condition is to be *distinguished from collapse*, the result of the injury, by its occurrence at the interval of a day or two after the injury; and *from pulmonary embolism* by its occurrence at an earlier period than that accident, which is most common in the third week, as well as by the particular nature of the accident, and the presence of fat in the urine in the cases in which that excretion can be examined.

If a patient who has been in the habit of indulging freely in alcohol become restless and be unable to sleep on the second or third day after an accident or operation which keeps him confined to bed, the surgeon may suspect the oncoming of *delirium tremens*. And if a few hours later he find his patient still more excited, delirious, with some fixed idea of a disagreeable character which makes him constantly busy (avoiding an imaginary foe, for example), with marked muscular tremor of the limbs, lips and tongue, jerky voluntary movements, the skin bathed in a profuse foul-smelling sweat, the tongue large, moist, covered with a white or brownish-white fur with sticky mucus adhering to its sides and to the teeth, morbid thirst, complete anorexia, constipation, dilated pupils, and rapid, soft, often dicrotous pulse, the *delirium tremens* is fully developed. When occurring after an accident or operation, it is sometimes called *traumatic delirium*, but as it does not differ in essential characters from idiopathic delirium tremens, it is better not to use a separate name for it. The taking of food and the securing of sleep are the two signs of improvement in this condition. If, on the other hand, the tongue become dry and brown, the delirium incoherent and muttering, and the patient cannot be made to answer questions, or if epileptiform convulsions interrupt the other symptoms, it indicates increasing nervous prostration, and death, heralded by complete coma, generally ensues. There is a marked tendency to the occurrence of low hypostatic pneumonia in severe cases of delirium tremens, and the surgeon should therefore carefully examine the chest every day.

If a patient with a recent wound, or a wound but recently healed, complain of pain and stiffness about the muscles of the back of the neck, and on examination these muscles are found firm from tonic contraction, and if a voluntary effort to bring them into action cause a painful spasm in them, the onset of *tetanus* is to be feared. And if this tonic spasm quickly spread to the muscles of the jaw and the face, then to those of the trunk, and eventually to those of the limbs (the hands usually remain free), while paroxysms of painful and very intense spasm occur in the affected muscles, causing opisthotonos, or emprosthotonos, or occasionally pleurosthotonos, the mind remaining clear, the temperature being normal, slightly raised, or ranging very high indeed, the diagnosis of *tetanus* is established. Cases of tetanus are divided into *acute*, those running a very rapid course, with frequent paroxysms; *chronic*, those in which the progress of the disease is more gradual and the intensity less marked; these cases provide the great majority of the instances of recovery from the disease; *idiopathic* when the disease arises without being immediately preceded by any known breach of surface. As very unusual features, may be mentioned: delirium, remission of the symptoms, and the first appearance of the spasm in the muscles immediately adjacent to the wound. The disease is distinguished (1) from simple *muscular spasm* by the occurrence of the paroxysms of very violent tonic contractions; (2) from *spinal meningitis* by the absence of pain and tenderness down the spine, the absence of shooting pains in the trunk and limbs apart from the paroxysms of contraction, by the absence of marked superficial hyperæsthesia, by the order in which the parts are affected, by the freedom of the hands and feet, and by the absence of palsy except from exhaustion in the last stages of the disease; (3) from *epilepsy* and *hystero-epilepsy* it is distinguished by the absence of unconsciousness, and the great liability to a fatal issue from apnœa, syncope, or exhaustion; (4) from *strychnia poisoning*, by the more gradual onset of the symptoms, the longer course of the disease, and the less frequency of the attacks of opisthotonos (strychnia poisoning is usually fatal in twenty-four hours), by the commencement and chief intensity of the disease in the muscles of the neck, jaw, and face, while strychnia affects first and most the muscles of the lower limbs, then those of the trunk and the muscles of respiration; (5) from *hydrophobia*, by the persistence of the muscular rigidity between the paroxysms, by the intense trismus as opposed to the marked laryngeal spasm of hydrophobia, by the absence of delirium or mania, and often by the shorter incubation period and the absence of the history of a bite of a rabid animal.

If a patient have been bitten by an animal suffering from rabies, and at some interval subsequently, usually between three weeks and three months, although it may be earlier or later than this period, he become very depressed in spirits, apathetic, irritable, or restless, and this be succeeded by a spasmodic attack brought on by an attempt to drink, the spasm affecting chiefly the muscles of the larynx, face, and those of inspiration, and ending in complete muscular relaxation; and if this be succeeded by other similar and more severe attacks, always brought on by some external excitation, such as the attempt to drink, or even the sight and thought of water, a sudden noise or bright light, a puff of cold air, or the contact of the hand; and with these symptoms there be great mental excitement and restlessness running on up to paroxysms of maniacal frenzy, fixed and terrible illusions, or irresistible impulses, with intervals of calm in which the patient may sleep; with moderate pyrexia, accumulation of sticky and frothy mucus about the mouth and throat, the diagnosis of *hydrophobia* may be made. In some cases small or large vesicles have been found around the frænum linguæ, but their significance is doubtful. If the patient do not die in the acute stage from respiratory or cardiac spasm, he passes into a stage of gradually increasing palsy, in which the mind becomes clear only to be again clouded by the increasing asthenia just before death. The signs by which hydrophobia can be distinguished from tetanus have been already given (page 73), but it must be carefully distinguished from what is called *false hydrophobia*, which may be a wilful or an unintentional close imitation of the real disease, and when ending fatally presenting great difficulty of diagnosis; chief reliance must be placed on discovering whether the patient have been concentrating his thoughts and attention upon the disease, constantly reading and talking about it, or dreading its onset, and on noting the occurrence of exaggeration of the symptoms, such as barking noises, snapping of the jaws, running about on all-fours, and so on, which are all popular delusions concerning the disease, and noting other departures from the usual course of the disease. Where recovery follows, the diagnosis of false hydrophobia becomes extremely probable, some would even say certain. Whenever possible, care should be taken to ascertain whether the animal suspected of inoculating the patient undoubtedly suffered from hydrophobia.

CHAPTER V.

THE DIAGNOSIS OF INJURIES OF THE HEAD.

FEW cases are of more interest or importance from a diagnostic point of view than those of injury to the head. With the exception of the scalp, the condition of which can be thoroughly explored, it may in some cases be quite impossible to determine whether serious injury has or has not been inflicted upon various parts of the head. The skull may be extensively fractured or bruised without causing any signs by which it may be recognised, and serious and various lesions of the cerebral membranes, or of the brain itself, may exist without symptoms enabling the surgeon to discriminate between them, or even to predicate their existence. It follows from this, that the utmost care must be expended upon every case of head injury, as those apparently trivial may really be most grave. While availing himself of all evidence which can enable him to make a positive diagnosis, the surgeon must never accept the absence of such positive evidence as sufficient to warrant the conclusion that lesions other than those clearly recognisable are not present. In other words, while symptoms may enable the surgeon to prove a positive, they do not warrant him in asserting a negative diagnosis.

Diagnosis being beset with so much difficulty, it becomes especially important that the examination of the patient should be made in the most thorough and painstaking way; and the mode of procedure, which is at the same time the simplest and the best, is, first, to search for signs of injury to the *scalp and pericranium;* then for those of *fracture of the bone;* and, finally, for those indicating *lesion of the contents of the cranium;* the affections of each of these three groups of tissues must further be divided up into *primary*, those produced more or less directly by the injury, and presented by the patients immediately, or within a few hours; and the *secondary*, those which indirectly result from the injury, and which manifest themselves only after an interval of days or even months; these are mainly inflammatory in nature.

A. **Injuries of the scalp.**—From falls or blows the scalp may be *bruised* or *wounded;* in the case of wounds, it must be determined to what depth they extend; if merely into the scalp there will not be gaping of the edges; if simply through the scalp (the most common form) the edges gape, but bare bone is not exposed; should the bone appear bare and smooth at the bottom of the wound, it shows that the pericranium has been wounded; the edge of the cut or torn pericranium may be felt as a thin, sharp edge. *Scalp wounds* may be *incised, contused*, or *flaps* of various extent may be stripped off the skull. The effects of *contusion* are not so apparent in the scalp as elsewhere, and in many cases the surgeon has to rely upon a knowledge of the nature of the injury inflicting the wound to guide him in this diagnosis. In some cases large portions or even the whole of the scalp may be completely torn away.

If a swelling form over the vault of the skull within a few hours after a blow or squeeze, it is either a collection of blood (*cephalhæmatoma*) or an *escape of cerebro-spinal fluid.* The latter is a very rare condition. (*See* page 82.) That the swelling is due to blood will be certain if it fluctuate in part only or indistinctly, or if there be a firm edge to the swelling, caused by coagulation of some of the blood, or if the scalp be discoloured or the swelling be opaque. Of *cephalhæmatoma* there are several varieties described, which can sometimes be distinguished one from another.

(1) If the swelling be firm, more or less flat and distinctly movable over the subjacent bone, it is a *hæmatoma in the scalp;* this may be small and *circumscribed*, or larger and *diffuse*.

(2) If the swelling be soft or fluctuating, giving in places a soft, crackling sensation to the fingers, and be not distinctly movable over the bone, it is a *circumscribed subaponeurotic hæmatoma.*

(3) If, however, the swelling be quite soft and fluctuating, and easily movable over the bone and under the scalp, being capable, perhaps, of passing from the occipital protuberance to the supraorbital arch, and from zygoma to zygoma, the whole scalp, indeed, being detached from the pericranium, it is a *diffused subaponeurotic hæmatoma.*

(4) If the swelling be absolutely fixed to the bone, while the scalp is movable over it, and especially if it correspond in outline to one of the cranial bones, being soft and fluctuating throughout, or presenting a firm edge, it is a *subpericranial hæmatoma.* This form is not unfrequently met with over the parietal bone in children at birth, being caused by the pressure of the pelvic bones or the forceps. When the margin of the swelling is firm, either from coagulation of the blood or effusion and more or less complete organisation of lymph, while the centre remains soft, it may be mistaken for a depressed fracture. The distinction can, however, readily be made by noticing that the firm edge of the swelling is compressible, and when indented by pressure the bone may be felt passing in an unbroken curve from beyond it into the centre of the swelling, and also by noticing that the firm edge rises gradually, and is itself raised above the bone outside it; in a case of depressed fracture the hard edge is not raised above the bone beyond it

nor is it compressible, while the bone within is felt to be distinctly below the proper level.

(5) If the swelling pulsate synchronously with the arterial pulse, and if the pulsation be lost when the superficial temporal occipital or supraorbital artery is compressed, or when all these vessels together are compressed, while coughing and straining does not cause the tumour to swell out, and especially if the pulsating swelling be movable over the skull, the tumour is a *pulsating hæmatoma*, due to the communication of a large artery with the effusion of blood.

Cephalhæmatomata usually undergo absorption, but the blood may remain fluid for a long time, leaving a fluctuating swelling, which will then be distinguished from every other similar swelling by the history of its formation. Occasionally they become inflamed and suppurate, and if a swelling, which by its history and characters is recognised as a hæmatoma, become more tense, hot, painful, very tender, with œdema around it, the skin over it being red, while the temperature is high, with quickened pulse, and especially if the patient have a chill or distinct rigor, it may be diagnosed as a *suppurating hæmatoma.*

In the diagnosis of the late consequences of injuries to the head, the recognition of a *scar* in the scalp may be of great importance, both as corroborating a history of a particular injury, and still more as localising it with precision. The development of a soft puffy swelling in the scalp was referred to by Pott as a valuable sign of subcranial abscess; but this has been only very rarely seen by other surgeons.

The **secondary complications of wounds of the scalp** are:

Abscess.
Cutaneous erysipelas.
Diffuse cellulitis.

(1) If the edges of the wound have adhered, but the scalp be boggy, œdematous and tender, and the patient complain of constant pain of a tensive and throbbing character, retention of *pus under the scalp* may be diagnosed, and this may be demonstrated by separating the edge of the wound, when the pus will at once escape.

(2) If with symptoms like the above a distinct fluctuating swelling be detected, it is an *abscess.* These abscesses are not unfrequent as sequelæ of erysipelas.

(3) If the skin of the scalp be found swelled, of a bright-red colour, hot, painful and very tender, the redness and tenderness extending over a wide area, considerably beyond the wound, and presenting a sharply defined raised edge, and if reaching over the forehead it be attended with œdema of the eyelids, and the patient be febrile, with rapid pulse, furred tongue, malaise, anorexia, headache, and gives the history of a sudden or acute onset of these symptoms, with a shiver or rigor, nausea or vomiting and severe headache, the disease is *cutaneous erysipelas of the scalp.*

(4) If with signs of severe constitutional disturbance, initiated possibly with a rigor, followed by high fever, rapid pulse, great weakness, headache or delirium, the scalp or the greater part of it be found greatly swollen and boggy, painful and tender, with œdema of the eyelids or ears, which may reach down even on to the face and neck, while a little turbid serous fluid oozes from the wound, it is to be recognised as *diffuse cellulitis of the scalp.* This condition must be carefully distinguished on the one hand from *cutaneous erysipelas* by the much greater swelling of the scalp and greater severity of the general disturbance; and on the other hand from a simple local *cellulitis or bagging of matter* under the scalp where the swelling is quite local, the general disturbance

much less, and where by opening up the recently or partially healed wound pus is freely evacuated with immediate subsidence of all the symptoms.

B. **Injuries of the skull.**—First examine the *vault* by passing the fingers gently over it, to note any *irregularity* of the surface, particularly any *depression* or *sharp edge* of bone. The cerebro-spinal fluid may escape under the scalp, and form a translucent tumour there. If there be a wound of the scalp, it should be examined for splinters of bone and for portions of brain matter, and then the finger should be passed in and the bone explored, any depression of the surface being carefully examined to determine its depth and extent and the direction of any fissures running from it, as well as the presence of detached fragments of bone; on holding back the edges of the wound a fracture may be seen, the broken edge of bone having a dark-red colour and an uneven surface. Very severe injury may be inflicted on the bones of the skull without producing any symptoms by which it may be certainly recognised, and surgeons often have to infer a contusion or fracture of bone from the nature of the violence inflicted, being quite unable to demonstrate its actual existence.

The **primary effects of injuries** inflicted upon the bones of the skull are:

Contusion.
Infraction.
Fracture.

(1) There are no positive signs whereby a *contusion* of bone can be recognised; it is only known or suspected to have occurred when certain *inflammatory sequelæ or necrosis* occur; it may be inferred in all cases of severe injury to the skull, especially when not attended with fracture.

(2) If in an infant at birth, or a young child in

whom the vault of the skull is still soft, a shallow smooth depression in the bone is felt, with rounded edge, it may be diagnosed as a depression or dent in the bone or *infraction;* such a depression without fracture is only possible in quite early life. The surgeon must not mistake for an infraction the yielding of an unclosed *fontanelle*, or of a softened spot of bone in *craniotabes;* in the latter there is no permanent depression, only a yielding of the bone under the pressure of the finger. (*See* page 384.)

(3) If an abrupt depression of the vault of the skull, with a sharp, perhaps irregular edge and uneven surface, can be felt through the scalp, the sharp edge being not raised above the bone outside it, and being quite incompressible, it is a *simple depressed fracture* of the vault of the skull.

(4) If on passing the fingers over the skull a sharp irregular edge of bone can be felt, it indicates a *simple fissured fracture* of the vault of the skull; if the fissure take the line of one of the sutures, it is a *separation of a suture.* In some of these cases mobility and crepitus may be detected along the line of fracture. Effusion of blood in or under the scalp may partially or completely obscure these simple fractures. The surgeon must not mistake for fractures the *normal sutures*, which may be felt as slightly raised ridges on the bones, and are always smooth and somewhat rounded; nor the slight smooth irregularities of the surface, which may be natural irregularities of the bone or the bossy elevations produced by *congenital syphilis;* the distinguishing features of all these are the facts of elevation above the surface, not depression, and their smooth rounded outline. It is often impossible to diagnose a *simple fissure* of the vault if there be no displacement of the bones.

(5) If, after a blow upon the forehead, or behind the ear, a soft puffy swelling gradually form and

increase, and it yield a distinct dry crepitus on manipulation, and if extensive gives a hollow percussion-note, it indicates *fracture into the frontal sinus or the mastoid cells, with emphysema.*

(6) If, after an injury to the vault of the skull, a tumour form over the part struck, and gradually increase in size for days, the swelling being translucent and fluctuating in every part, and becoming tenser and fuller when the child cries, being without any sign of inflammation in the scalp or of induration around the margin, it is a collection of *arachnoid or cerebro-spinal fluid beneath the scalp,* and is proof of the existence of a *fracture of the vault.* The swelling may begin to form at once after the injury, or not be noticed for several days; in cases where the communication with the interior of the skull is very free, the swelling pulsates synchronously with the brain.

(7) Where there is a wound in the scalp leading down to the bone, it is easier to determine with certainty the existence of a fracture, and for this we rely upon sight and touch. If at the bottom of a wound an irregular red line be seen, from which, if the pericranium be torn, blood issues or may be squeezed, and especially if by pressure slight movement along this line can be detected, or if the finger-nail or the probe can be inserted into the line and detect a sharp edge of bone, a *compound fissured fracture of the vault* of the skull is to be recognised. This fissure must not be confounded with a *suture* exposed in the wound, which is not a red bleeding line, nor is the edge of the *torn pericranium or temporal fascia* to be mistaken by the finger for the edge of bone; the edge of the dense fibrous membrane can in either case be recognised by its slight yielding to pressure, by its smoothness, and by its not grating under the finger-nail; the mistake, however, has been made. If such a fissure be placed exactly in the line of a cranial

suture, it may be distinguished as a *separation of a suture.*

(8) The finger in the wound will readily distinguish those varieties of fracture known as *compound depressed, comminuted, punctured,* and *saucer fractures.* If the bone be fissured, and there be slight depression as seen and felt, it may be a *fracture of the outer table* of the bone only, and similarly there may be an entire outer table and a *fracture of the inner table* only; neither of these conditions can be with certainty diagnosed. Where, however, from an injury inflicted on the outer surface of the bone, there is depression and splintering of the outer table, it may be inferred that there is still greater injury of the inner table, and the more nearly any fracture approaches to the form of a punctured fracture, the greater becomes this probability. If a probe can be passed into a fissure and under the bone laterally, and still feel firm bone beneath it, it indicates a *separation of the two tables* of the bone, with depression of the inner plate.

The signs of **fracture of the base of the skull** are (*a*) *hæmorrhage,* (*b*) *escape of cranial contents,* (*c*) *injury to cranial nerves.* The *hæmorrhage* may take place into the orbit, the nose, the pharynx, the ear, or under the deep muscles below the occiput. It is characterised by its long continuance, often going on for twenty-four or even forty-eight hours. In the orbit and in the neck this leads to the formation of a continuously-increasing ecchymotic swelling In very severe lesions *brain* matter may be forced into the nose or pharynx. More frequently, *cerebro-spinal fluid* trickles from the nose or the ear; it is known by being limpid, of very light sp. gr., yielding only a slight precipitate on boiling and the addition of nitric acid, or, if it escape from the nose, giving but a faint precipitate with acetic acid (mucin), and yielding a slight reddish-yellow precipitate of cupric oxide when boiled with Fehling's solution (glucose). Injury to the cranial nerves is shown by motor or sensory paralysis.

(9) If after an injury to the head or upper part of the face, there follow an effusion of blood under the ocular conjunctiva, which may or may not spread subsequently to the eyelids (usually reaching the lower before the upper lid), and, if extreme, causing protrusion of the eye-ball, it indicates a *fracture of the roof of the orbit.* Hæmorrhage into the eyelids may be caused by a simple contusion (black-eye), or by a fracture of the malar or upper jaw-bone, in which cases the subconjunctival hæmorrhage is absent, or much less marked than the effusion into the lids. In some fractures of the roof of the orbit and of the orbital arch, in which the periosteum lining the orbital cavity is not torn, the blood does not get under the conjunctiva, but only into the lids, and in such a case a diagnosis could only be made if it was certain that there had been no direct injury of these parts.

(10) If, after an injury to the head or nose, there be hæmorrhage from the nose continuing for some hours, or even a day or more, or if succeeding the flow of blood there be a copious discharge of cerebro-spinal fluid from one or both nostrils, there is a *fracture of the base of the skull.* If the injury have been received upon the bridge of the nose or the anterior part of the skull, or have been inflicted from the nasal cavity, the fracture will be in the *roof of the nose;* but if the injury have been inflicted upon the vertex or the middle of the side of the head, the fracture is probably *into the tympanum*, the blood escaping into the nose through the eustachian tube. Should the patient be conscious, unwonted deafness on the same side would confirm this diagnosis.

(11) If after an injury to the middle zone of the vault of the skull, or a heavy fall upon the feet or the

buttocks, there be bleeding from the ear continuing for many hours, or if after hæmorrhage of shorter duration there be a copious flow of cerebro-spinal fluid; and especially if the hæmorrhage be accompanied with deafness, or facial palsy, and if an examination of the ear show the meatus to be intact and the membrana tympani ruptured, there is a *fracture of the middle fossa of the base of the skull;* and if the cerebro-spinal fluid escape, it proves further the laceration of the tube of arachnoid membrane around the seventh cranial nerve. Transient hæmorrhage may be caused by lacerations of the meatus or of the membrana tympani; a slight flow of watery fluid might possibly be an escape of liquor Cotunnii from the inner ear; and if the fluid were richly albuminous it would indicate that it was blood serum or inflammatory exudation.

(12) If a patient who is known to have received an injury to the head, or may have received such an injury, after an interval vomit some dark slightly altered blood, it becomes highly probable, in the absence of evidence to the contrary, that the blood has flowed into the pharynx from a fracture of the base of the skull, and been swallowed. The lips, mouth, and tongue should be carefully examined to exclude hæmorrhage from that source. If there be bleeding from the nose at the same time, or signs of such immediately after the accident and before the patient assumed the horizontal position, and if the patient be conscious of swallowing blood, or, when unconscious, if the movements of deglutition are seen to occur spontaneously from time to time, and especially if on inspection, or on passing the finger to the back of the mouth, blood be found in the pharynx, the diagnosis of *fracture of the base of the skull* is assured. In the absence of other evidence it will be impossible to determine which fossa is injured, as the blood may

flow into the pharynx from the nose, or the ear, or from a fissure in the vault of the pharynx.

(13) If after an injury to the posterior part of the skull, or a fall upon the feet or the buttocks, a puffy swelling appear around the mastoid process, or on the side of the neck, or below the occiput, and be followed by staining of the skin over it with blood, especially if the swelling be not over the part struck, and do not come on for some few hours after the accident, and then go on increasing for some hours, it indicates a *fracture of the posterior fossa of the base of the skull.*

The **secondary effects upon the bones** of the skull of injuries inflicted upon them are :

Necrosis.
Osteo-myelitis, and
Osteo-phlebitis.

(1) If a scalp wound do not heal, but, on the contrary, the soft parts retract from the bone, and this is seen to be dry, bare, and of a dull white colour, there is *necrosis.* It will not be possible to tell to what depth the necrosis extends until the sequestrum separates or is removed ; but so long as there are no signs of intracranial inflammation, there is no indication that the inner table of the bone is involved. Necrosis of the bone may occur from contusion without a wound in the scalp. It will then be indicated by a puffy swelling of the scalp, which when cut into exposes bare, dry, dull white bone.

(2) There are no positive signs whereby *osteo-myelitis* and *osteo-phlebitis* may be recognised with certainty before they have led on to their more serious sequelæ, *necrosis*, *pyæmia*, and *thrombosis* of the *sinuses.* But if, two or three weeks after an injury to the head, there be pain in the head, fever, and tenderness of the skull when pressed upon through the scalp,

or slight deep swelling of the scalp, *osteo-myelitis* may be suspected. When extensive it may lead to the death and separation of large portions of the calvaria.

C. **Lesions of the cranial contents** cause either *irritation* or *paralysis* of the nervous apparatus, motor, sensory or reflex. Irritation of motor structures is shown by *muscular twitchings* or *spasms;* irritation of sensory parts causes *pain* and *hyperæsthesia;* irritation of reflex nerve centres leads to *increased reflex action*. *Motor palsy* is estimated by noticing the position of the limbs, the absence of all resistance to passive movements, and stertorous breathing, or flapping of the lips and cheeks with respiration. *Sensory palsy* is recognised by the insensibility of the patient to all external impressions, such as sound, light, pinching, pricking. *Reflex palsy* is specially indicated by a fixed condition of the pupils, and the failure of contact with the conjunctiva to cause contraction of the orbicularis palpebrarum. From these symptoms the surgeon must attempt to *define the position and the nature of the lesion.*

(1) **The position of a lesion.**—(*a*) Paralysis or irritation of a single nerve, or of nerves lying close together in the skull, is probably due to some lesion of the nerve trunk or trunks on the same side; *e.g.* paralysis of the fourth cranial nerve, or of the two parts of the seventh nerve. (*b*) When, however, the paralysis or the irritation affects nerves whose controlling cortical areas lie in close juxtaposition, it indicates a cortical lesion of the opposite side. (*c*) If the palsy affect a very wide extent of muscles, it points to a lesion of some part of the main strands of nerve fibres in the central nervous system passing from the cortical centres to the nerves of distribution; *e.g.* ordinary hemiplegia from hæmorrhage into the corpus striatum.

(*d*) **Electricity in diagnosis.**—Although electricity has not yet been largely used by surgeons for purposes of diagnosis, there is one way in which it affords most valuable aid in localising the position of a paralysing lesion. It depends upon the fact that when a nerve trunk in any part or its centre is injured, the irritability of the paralysed muscles to the faradic current rapidly diminishes until it finally disappears, while they respond more readily to the constant current. This increase of voltaic irritability, and diminution or loss of faradic irritability, are known as the *reaction of degeneration.* This sign can be observed within a few days of the onset of paralysis, and becomes more and more marked; it is always associated with rapid wasting of the affected muscles; it is applicable to both the cranial and spinal nerves. Where, therefore, paralysed muscles show this reaction of degeneration, it is to be accepted as certain evidence that the lesion causing the paralysis is affecting the nerve supplying the muscles, or the nerve nucleus; if no such reaction of degeneration be found, it shows that the lesion is situated in some part of the nervous apparatus above the nerve centre. This sign tells us nothing of the cause of paralysis, only its site.

(2) **The nature of a lesion** is indicated partly by the class of symptoms which it occasions, and partly by their time of onset. (*a*) *Irritation* is caused by slight compression, by superficial or partial laceration of the brain substance, or by inflammatory congestion; it rarely affects the cranial nerve trunks. (*b*) *Paralysis* is caused by complete laceration of brain or nerve, by firm compression by bone, blood, or inflammatory exudation, or by shaking up of the brain with more or less appreciable contusion, or by shock. (*See* page 57.) (*c*) Symptoms produced immediately by an injury are caused either by *concussion* of the brain or by *compression* by displaced bone. (*d*) Symptoms coming on within a short interval of

an injury (an interval measured by hours) are due to the pressure of *effused blood.* (*e*) Symptoms arising later on are the result of *inflammation.*

Cerebral localisation.—It has in quite recent years been shown that the cortex of the cerebrum is functionally differentiated into a number of centres. When a lesion of the cortex has been produced, observation of the function or functions affected enables, or may enable, a diagnosis of the exact seat of the lesion to be made; when the lesion is one that admits of surgical treatment (abscess, a depressed splinter of the internal table, etc.) this becomes of great importance. There is still some difference of opinion as to the precise seat of the various motor and sensory areas; and in what follows I am accepting the views put forth by Dr. Ferrier.

The cortex of the anterior two-thirds of the frontal lobe of the brain (that corresponding to the frontal bone) is not the seat of any centre for voluntary motion, or of perception of sensations, but is probably concerned with the higher mental functions only. The region of the brain bounding the fissure of Rolando, including the posterior extremities of the three horizontal frontal convolutions, the whole of the descending frontal and ascending parietal, and the parietal lobule, together with the inner surface of the marginal convolution, is the motor area, which is further divided up into special centres; the temporo-sphenoidal lobe, with the supra-marginal and angular gyri, are the seats of the perception of the special centres. The part of the motor area adjacent to the great longitudinal fissure is the centre for the movements of the legs; the lower part of this area is the centre for the arms; and the part in front of the lower extremity of the fissure of Rolando, that part of the area in front of the ear, is the centre for the face. The mesial surface of the marginal convolution is the centre for the trunk muscles, the anterior part representing the neck, the middle part the shoulders, and the hinder part of it being the centre for the lower muscles of the trunk. The superior temporo-sphenoidal convolution has been shown to be the centre for hearing. To delineate these centres on the scalp, the following directions will suffice: Place the head so that a line drawn from the lower edge of the alveolar process of the upper jaw to the lowest part of the occipital bone is horizontal. The motor area is limited above by a line half an inch from the middle line, and below by a horizontal line drawn backwards from the external angular process of the frontal bone. Its anterior limit corresponds with the coronal suture, and is approximately marked by a line drawn vertically up from the middle of the zygomatic arch. Now draw two vertical lines, one through the external auditory meatus, and the other 50 mm. behind this; the fissure of Rolando will be under a line drawn obliquely from the top of the posterior of these two lines to the spot where the anterior of them crosses the line drawn horizontally back from the external angular process. The centre for hearing lies immediately below this horizontal line, and parallel with it; that for vision will be found above this line, and just behind the posterior of the two vertical lines above mentioned. Broca's speech-centre is immediately above the level of the external angular process of the frontal bone, and one inch behind that point of bone. For many further details regarding this most important subject, the reader is referred to the writings of Bastian, Ferrier, Gowers, and others.

The primary lesions of the cranial contents are:

Concussion.
Contusion and laceration.
Compression.

(1) If after an injury to the head, or a general shake of the body, the patient be temporarily unconscious, with muscular relaxation (falling down) and pallor, or if he simply feel giddy and faint, with some nausea, the symptoms are to be attributed to *concussion of the brain* in its milder form.

(2) If immediately after such an injury a patient be found apparently quite unconscious, but yet capable of being roused to some slight extent by loud shouting or a strong sensory impression (pinching or a bright light), with complete muscular relaxation, the limbs being flaccid and motionless, and the urine and fæces have passed involuntarily from relaxation of the sphincters, the surface being pale and cold, the pulse small, soft, and frequent (sometimes irregular, and in extreme cases imperceptible at the wrist), the respiration shallow and noiseless, the pupils either unaltered in size or slightly contracted or dilated, or unequal on the two sides, but acting slowly to a bright light, the case is one of severe *concussion of the brain*. All grades of severity in the symptoms, from slight temporary disablement up to sudden death, are met with in cases which are to be grouped under the heading of *concussion*. Where the symptoms are severe, there is always a distinct amount of contusion and laceration of the brain substance, as proved by post-mortem evidence.

(3) If, along with the symptoms of concussion of the brain, there be twitchings of certain groups of muscles, or more general convulsions, or if the patient exhibit great irritability of manner, and lie curled up with all his limbs flexed, eyelids closed, and if he resent all interference, resisting attempts to open his eyelids or mouth, the symptoms may be accepted as evidence of *contusion and laceration* of the surface of the brain; by closely noting the muscles affected, the seat of the brain lesion may be approximately or accurately determined.

(4) If, in a case of injury to the head, brain matter (proved to be such by microscopical examination) be found mixed with the blood from the wound, in the hair of the scalp, or in the nose, ear, or mouth, or lying in a wound into the orbit, it of course demonstrates *laceration of the brain;* and it must be remembered that patients may present themselves with brain matter thus extruded from the cranium without any symptoms to indicate so grave a lesion, without unconsciousness or paralysis.

(5) Whenever after an injury cerebro-spinal fluid is found escaping from the skull, it proves that there is a *laceration* of the visceral layer of the *arachnoid membrane* communicating with a fracture of the bone. When the escape of this fluid is very abundant, and particularly if it flow from a fracture of the vault, it is accepted as evidence of a *laceration* of the brain opening up one of the *ventricles.* The cerebro-spinal fluid may escape from a wound in the soft parts, or form the cystic tumour of the scalp described on page 82; as a complication of fractures of the vault it is a very rare circumstance. The distinctive characters of cerebro-spinal fluid have been already given. (*See* page 83.)

(6) If after an injury to the head a patient be found absolutely unconscious, it being impossible to arouse him or to make him answer questions, with fixed dilated pupils, slow, deep, stertorous breathing with flapping of the cheeks during expiration, slow, full, laboured pulse, retention of urine and involuntary passage of fæces, and paralysis, general or of one side of the body only, these symptoms are caused by *compression of the brain.* An attempt must be made to determine the source of the compression, and first of all *depressed bone* must be sought; and if a depressed fracture be detected, and the symptoms of compression are known to have been instantly produced, it may be

regarded as the cause of the compression. If, however, the symptoms of compression have come on gradually and at a short interval after the accident (an interval during which the patient may have been quite conscious, or showing more or less evidence of brain concussion), or if while under observation it be noted that the signs of compression are increasing, the coma becoming more deep and the paralysis more extensive, it indicates clearly *intracranial hæmorrhage.* When there has been an interval of consciousness between the injury and the oncoming of the symptoms of concussion, showing that the brain has not been seriously shaken or contused ; and, further, if the paralysis is or was at first unilateral, we may diagnose that the hæmorrhage has taken place between the bone and the dura mater from rupture of a meningeal artery or wound of a sinus ; while under the other conditions we have evidence of more severe direct injury to the brain, making it probable that the blood clot is situated on or in the brain. The symptoms of compression coming on after an interval of days or weeks from the injury, and preceded by signs of intracranial inflammation, indicate that the cause is the presence of *inflammatory products.* (*See* page 97.)

If the surgeon should trephine the skull on the supposition that there is a clot of blood between the bone and the dura mater, but on removing the piece of bone fail to find the clot, but notice that the untorn dura mater bulge up into the trephine hole, and is pulseless, and of a dark-blue colour, he may diagnose *arachnoid hæmorrhage,* and make an incision into the dura mater. When the history and symptoms indicate extrameningeal hæmorrhage, the surgeon must determine on which side the clot of blood is. Two signs will guide him. If there be paralysis on one side only, or if the paralysis be more marked on one side than the other, or if the general paralysis have been preceded by unilateral spasm, the blood-clot is on the side opposite to the paralysis or spasm. And further, the hæmorrhage will be on the same side of the skull as the injury; and therefore if a bruise can be detected on one side, or if there be a wound, this will guide the surgeon as to the position of the clot, and indicate where the trephine should be applied if that treatment be indicated. It must be stated that the symptoms of intracranial hæmorrhage are often mixed with and obscured by those of severe concussion and laceration of the brain; they are mainly characterised by paralytic phenomena.

(7) Cases often present themselves in which there is great difficulty in determining whether the symptoms are due to the effects of *alcohol* or to a serious lesion of the brain. Whenever there is this doubt, and whenever a drunken man is known to have received a severe injury to the head, he should be kept quiet for some hours, until the effects of the alcohol have passed off. The signs of alcoholism upon which reliance is generally placed are the peculiar odour of the breath, the flushed face, heavy but not stertorous breathing, the contracted pupils, which dilate on arousing the patient, incoherent delirium, a tendency to become quarrelsome, tremor and unsteadiness of gait if able to walk at all, the absence of paralysis, and finding the bladder full of urine, in which alcohol may sometimes be detected. The history where obtainable is of course of the highest importance.

(8) In other instances the question arises whether a person found insensible and paralysed has had an attack of *apoplexy*, and fallen down, or has received a serious head injury causing the paralysis. Here again there are cases in which it may be necessary to suspend judgment for a time, or even altogether. For the symptoms produced by a clot of blood in the brain are of course the same whether the rupture of the blood-

vessel be spontaneous or excited by a blow. In all such cases the age of the patient and all the attendant circumstances must be carefully noted, and the heart and the urine should be examined, as the detection of a cardiac murmur or aortic aneurism, or of albuminuria, would be strong corroboration of the diagnosis of apoplexy. Careful search should be made for a wound or contusion of the scalp, depression of bone, bleeding from the nose, ear, or pharynx. A disproportion between the loss of consciousness and the paralysis, if present, would be of great assistance in the diagnosis, for in traumatic cases the sensorium, as a rule, suffers much more than the motorium, while in the idiopathic cases there may be complete hemiplegia with only very transient insensibility.

With regard to **lesions of cranial nerves,** the following points are of practical importance.

Loss of smell is the sign of injury to the olfactory nerve; but care must be taken to ascertain that the nasal fossa is clear, and not obstructed with blood-clot, displaced bone, or cartilage.

Injury of the third nerve often affects only a part of the nerve, and causes partial palsy; thus a combination of ptosis and a dilated fixed pupil is not infrequent.

Paralysis of the superior oblique muscle causing diplopia below the horizontal meridian, and internal strabismus only when the eye-ball is directed downwards, may be due to a lesion of the **fourth nerve,** or of its centre, or to interference with the play of the tendon of the muscle in its pulley; any thickening, pain, or tenderness at the seat of the pulley would render the latter the more probable diagnosis.

The fifth nerve is rarely affected alone; when the lesion is partial the cornea rapidly sloughs.

Internal strabismus without palsy of any muscles except the external rectus points to injury of the **sixth cranial nerve** alone.

The seventh nerve is the one most frequently injured in fracture of the skull; the signs of facial palsy are unmistakable. In estimating deafness from injury to the portio mollis, reliance must be placed upon failure to appreciate sounds transmitted through the cranial bones rather than upon those transmitted through the auditory meatus and tympanum, as these may be obstructed with blood-clot.

The eighth and ninth nerves are rarely injured; dysphagia, dyspnœa with slow respiration, altered rhythm of the heart's action, palsy of the tongue, and anæsthesia of the pharynx and back of tongue, are the signs by which the lesion would be recognised.

The secondary lesions of the cranial contents are:

(1) Hernia cerebri.
(2) Intracranial inflammation and suppuration.

(1) If after a compound fracture of the skull, or the operation of trephining, or the removal of a sequestrum from the vault of the skull, a soft mottled grey and dark-red tumour protrudes through the aperture in the bone, and if of large size, grows in a mushroom-like form, bleeds easily when touched but is not sensitive, exhibits an expansile pulsation synchronous with the carotid pulse, and is distended by crying or coughing, or any effort which increases the intracranial pressure, we have to do with a *hernia cerebri.* Microscopic examination of a portion of the mass will prove beyond all doubt the nature of the fungus if large irregular nerve cells be detected. The history of injury to the bone preceding the appearance of the fungus at once distinguishes it from pulsating malignant tumour. (*See* page 382.)

(2) When, after an interval of from two or three

days to weeks, months, or even years, after an injury to the head, there is persistent headache with intolerance of light and sound, contraction of the pupils, flushed face, fever, quick full sharp pulse, vomiting, with a thickly furred tongue and foul breath, and if these symptoms run on into delirium, followed by twitchings, convulsions, strabismus and coma, it is undoubted that *diffuse traumatic meningitis* exists. Of this group of symptoms there are, however, many modifications; pain alone may be present, and is of all symptoms the most frequent and constant, and when localised to the seat of the injury indicates a limited inflammation. In other cases muscular twitchings or paralysis may be the only sign of secondary intracranial mischief. It is important to remember that *abscess of the brain* may exist without any symptoms, and that not only may there be no fever, but it would even seem that a subnormal temperature is a frequent event in this complication. Sudden coma from the bursting of an abscess into the arachnoid cavity, or a sudden discharge of pus from the nose or ear, may be the first sign of a cerebral abscess. If, on account of symptoms of local intracranial inflammation, the interior of the cranium be explored, pus may be found outside the dura mater; and whether or not it be found, the surgeon should carefully note whether that membrane bulge up into the hole in the skull, and whether it pulsate. If it thus bulge up, and do not pulsate, he may diagnose subdural suppuration, and incise the membrane; but if these symptoms are not present, the surgeon should, with a fine exploring needle or trocar, puncture the brain in one or more directions in the hope of reaching a cerebral abscess.

Intracranial inflammation may cause, as its earliest symptom, spasm of muscles on the opposite side of the body; this is particularly characteristic if the muscles have been previously paralysed by compression

h[illegible] [illegible] spasms affect muscles
cl[illegible] [illegible] immediately adjacent
A[illegible] [illegible] muscles. [illegible]
o[illegible] [illegible] diagnosis [illegible]
c[illegible] [illegible]
t[illegible] [illegible]

[illegible]

of the palsy. By the latter we are able to judge of the actual cause of the paralysis; by the former we are able to localise the lesion.

The *extent of the paralysis* should be carefully determined; the power of voluntary motion, of sensation, and the condition of the various reflexes being separately and systematically investigated. The first use of the information thus obtained will be to decide whether the lesion is situated in the spinal cord, or in the nerves arising from it. Wherever the palsy is complete below a certain horizontal plane, involving both voluntary motion and sensation, it is undoubtedly due to *injury of the spinal cord.* But it requires a very complete crush of the cord to abolish entirely all sensation in the parts below, for if even a small portion of the cord be intact it will suffice to conduct some sensation, and hence it is that complete and absolute loss of sensation is more often met with in cases of injury to nerve trunks. Where the paralysis corresponds to the distribution of an individual nerve or nerves, it is due to lesion of those nerves. But a limited lesion of the cord may produce a limited paralysis of sensation or motion, according to the part of the cord affected; *e.g.* a lesion of the lateral column of the cord may cause paralysis of voluntary motion on the same side without affection of sensation or of the reflexes, and without marked wasting of the paralysed muscles; and similarly, a lesion limited to the posterior column of the cord may cause disorders of sensation without loss of power of voluntary motion. Injuries do not observe the strict regional limitations often found in diseases of the cord.

If paralysis ensue immediately on the receipt of an injury, it is due to some interference with the functions of the part caused directly by the injury, either *concussion* or *crushing*, and the diagnosis between these two will be readily made by of their cortical centre, or if the spasms affect muscles under the governance of centres immediately adjacent to those connected with paralysed muscles. By noticing the distribution of the spasm, an exact diagnosis of the seat of the lesion can be made, and a gradual extension of the convulsions or paralysis from group to group of muscles is characteristic of cortical lesions, progressively implicating neighbouring centres.

CHAPTER VI.

THE DIAGNOSIS OF INJURIES OF THE SPINE.

INJURIES of the spine derive their chief importance from the liability to implication of the spinal cord or of the spinal nerves. Paralysis at a distance from the seat of injury is the great symptom of injury to the cord or nerves, and as, in cases where these parts have been injured, any forcible manipulation may lead to further and serious mischief, the examination should be so conducted as to determine, first, whether the cord or nerves have been injured, and, if so, where; then whether the bones are fractured or dislocated; thirdly, whether the ligaments or muscles have been strained, torn, or bruised; while, last of all, lesions of the skin must be investigated.

1. **Injuries of the spinal cord and nerves** are indicated by *paralysis* and sometimes also by signs of *irritation;* what has been written in reference to these signs of intracranial mischief (page 87, *et seq.*), applies with almost equal force to injuries of the spine. In the investigation of traumatic paralysis for the purpose of diagnosis, two points must receive especial attention, its *extent*, and the *time and mode of onset*

of the palsy. By the latter we are able to judge of the actual cause of the paralysis; by the former we are able to localise the lesion.

The *extent of the paralysis* should be carefully determined; the power of voluntary motion, of sensation, and the condition of the various reflexes being separately and systematically investigated. The first use of the information thus obtained will be to decide whether the lesion is situated in the spinal cord, or in the nerves arising from it. Wherever the palsy is complete below a certain horizontal plane, involving both voluntary motion and sensation, it is undoubtedly due to *injury of the spinal cord.* But it requires a very complete crush of the cord to abolish entirely all sensation in the parts below, for if even a small portion of the cord be intact it will suffice to conduct some sensation, and hence it is that complete and absolute loss of sensation is more often met with in cases of injury to nerve trunks. Where the paralysis corresponds to the distribution of an individual nerve or nerves, it is due to lesion of those nerves. But a limited lesion of the cord may produce a limited paralysis of sensation or motion, according to the part of the cord affected; *e.g.* a lesion of the lateral column of the cord may cause paralysis of voluntary motion on the same side without affection of sensation or of the reflexes, and without marked wasting of the paralysed muscles; and similarly, a lesion limited to the posterior column of the cord may cause disorders of sensation without loss of power of voluntary motion. Injuries do not observe the strict regional limitations often found in diseases of the cord.

If paralysis ensue immediately on the receipt of an injury, it is due to some interference with the functions of the part caused directly by the injury, either *concussion* or *crushing,* and the diagnosis between these two will be readily made by noticing whether the early symptoms gradually or quickly pass off, or remain permanent; in the former case it shows that the injury was not a severe breach of continuity, but only *concussion*, while when the paralysis continues permanently it indicates that its cause was a severe and permanent structural lesion, such as is usually termed a *crush* of the spinal cord. If, however, the paralysis does not ensue immediately on the receipt of the injury, it cannot have been caused directly by it; should the symptoms of palsy supervene after a very short interval, one to be measured at the most by hours, they may be confidently attributed to the effects of *hæmorrhage;* while if they come on after a longer interval, they are caused by *inflammation*, or *myelitis*. It is to be noted also that any increase in the paralytic symptoms is to be similarly explained; that occurring quickly (within a few hours after the injury) being attributed to *hæmorrhage*, while that occurring at a longer interval (after twenty-four or forty-eight hours) is to be attributed to *myelitis*, spreading from the part primarily injured. These rules are exactly the same as those which serve as a guide in the diagnosis of the cause of the nervous phenomena in head injuries.

The observer's knowledge of anatomy will enable him to fix the seat of the lesion of the spinal cord by the extent of the paralysis. But just a few leading points may be here cited. (*a*) Below the first lumbar vertebra (sometimes twelfth dorsal or second lumbar) the spinal canal contains only the nerves of the *cauda equina*. (*b*) If there be complete motor and sensory palsy of the lower limbs, with loss of sensation as high as the umbilicus, it indicates a lesion of the cord at the level of the *ninth dorsal vertebra*, or opposite the roots of the tenth dorsal nerve. (*c*) If, however, the palsy involve the muscles of the belly wall and the intercostal spaces, and the anæsthesia extends up to about the second rib, and involves also an area on the inner and back part of the skin of the arm, it indicates a lesion of the cord opposite the *first dorsal vertebra.* (*d*) If the palsy involve also the upper limb, sensation being perfect over the head, face, neck, and just below the shoulder and clavicle, the respiration being solely diaphragmatic, it points to a lesion opposite, or but very slightly above, the *fifth cervical vertebra.*

By noting the state of the "*reflexes*" very important information is obtained. A "*reflex*" may be lost by interruption of its afferent or efferent path, or by paralysis of its centre. When, then, it has been determined that there is a lesion of the cord at a particular level, and there is no evidence of injury to the nerves below, the condition of the reflexes whose centre is in the part of the cord below this level will indicate the functional state of that part of the cord. For example, in a case of crush of the spinal cord by a fracture-dislocation of the fifth cervical vertebra from a fall on the head, if we find that the plantar, patellar, cremasteric, anal, vesical, gluteal, abdominal and epigastric reflexes are preserved, it will indicate that the cord below the lesion is functionally active, and *vice versâ.* It must be remembered that immediately after such an injury as we have supposed, the spinal cord below will be temporarily paralysed by "concussion"; but this should pass off in a few hours, and if after this interval the reflexes cannot be obtained, it indicates some more serious and lasting lesion of the centre. This same symptom may of course be used to detect the functional condition of the cord above as well as below the lesion. In estimating the "reflexes" under these circumstances, the observer must bear in mind the simple physiological effect of shutting off all volition. For instance, when the finger is passed within the anus of a healthy man, the sphincter contracts by a simple reflex stimulus, much strengthened by a strong voluntary effort, and therefore in a crush of the cervical cord where all voluntary effort acting upon the rectum is shut off, the anal contraction will be much slower and more feeble, even if the reflex action be perfect. Similarly in micturition; when the bladder is full a stimulus is conveyed up to the micturition centre in the lumbar enlargement of the cord, which is reflected along motor nerves to the detrusor urinæ muscle; but volition also comes into play, and brings other muscles into action, notably those of the abdomen, and sometimes many of those of respiration; micturition so performed is a quick and powerful expulsive effort; but if the voluntary part is shut off the mere reflex act is in comparison slow and feeble. There are certain paralytic phenomena which demand a few words further; we shall notice only those which are constantly coming under the observation of surgeons.

Incontinence of urine.—Where the centre in the lumbar enlargement of the cord and the third and fourth sacral nerves are intact, but the path of sensory and motor impressions along the cord above is completely severed, there will be at first retention of urine during the condition of shock or concussion, but when this passes off there will be reflex discharges of urine, more frequent and less forcible than in health, and of which the patient will be entirely unconscious. Should only the motor path in the cord be affected, the patient will be conscious of the passage of urine, but quite unable to influence it, while if only the sensory tract be injured he will in the absence of sensation make no voluntary effort either to restrain or to assist the reflex emptying of the bladder. But if the centre in the cord, or the nerves passing between it and the bladder, be the seat of the lesion, all reflex action is abolished, periodical discharges of urine do *not take place, but* true incontinence of urine, gradually becoming absolute, is established, the urine trickling out of the urethra as constantly as it trickles into the bladder, a little lodging in that viscus under the action of gravity, or restrained by the resistance to its discharge offered by the long and doubly curved urethra.

Priapism is the name given to the condition of erection of the penis frequently observed in spinal injuries. It may be extreme even to the point of extravasation of blood, but is more often partial and incomplete. It is a sign that the erection-centre in the lower part of the spinal cord is cut off from the inhibiting influence of the higher centres by some intercepting lesion. It is not usually met with in crushes of the lower part of the cord, but in those of the cervical and upper dorsal regions.

Incontinence of fæces.—The centre governing the contraction of the sphincter ani is situated in the lumbar enlargement of the cord, and if it and the nerve paths between it and the rectum are intact, the presence of the finger in the anus or of fæces in the rectum will cause reflex contraction of the sphincter. If the cord is crushed above this centre, when the pressure of the fæces becomes increased beyond a certain point, or at an earlier period if they be fluid, the sphincter yields, and a discharge takes place unknown to the patient. This is not true "incontinence of fæces," but merely "*involuntary and unperceived discharge of fæces,*" and the act will be repeated only at distinct and even long intervals. Where the lumbar enlargement of the cord or the cauda equina is crushed, the sphincter ani does not respond to the presence of the finger within that aperture, or of fæces in the rectum, and the expulsion of the latter by peristaltic action is unopposed; as, however, except in the condition of diarrhœa, fæcal matter passes into the rectum only occasionally, we have not a constant passage of fæces, but from time to time an "involuntary and unperceived discharge of fæces," which becomes specially troublesome only when the evacuations are loose. The student will notice that the distinction between these two conditions, or between the effects of lesion of two parts of the spinal cord, is to be made out by the finger introduced within the anus, and not by noticing the discharge of fæces. In connection with this subject it may be pointed out that the very obstinate constipation which is frequently observed in cases of crush of the upper dorsal or lower cervical spinal cord, while partly to be explained by the paralysis of the abdominal muscles, is probably to an important degree dependent upon damage to centres in the spinal cord, regulating the peristalsis of the various sections of the alimentary canal.

Bed-sores and alterations in the urine may be mentioned together, as each is attributable to two classes of causes. Bed-sores coming on after some days are due to the effects of pressure, friction or the irritation of urine or fæces upon the paralysed parts, and are to be obviated by careful nursing. But in other cases large and deep bed-sores form quite early (within two or three days) where such causes can be absolutely excluded, and these are to be attributed to irritative lesions of the spinal cord; but whether they depend upon vaso-motor changes, or injury to special "trophic" centres, or are to be ascribed to unusual impulses passing along the nerves, is still a matter for discussion. Similarly the changes in the urine, its alkalinity, decomposition, turbidity, and admixture with muco-pus, may be attributed to the decomposition of the urine started by and dependent upon micro-organisms introduced by the catheter passed to relieve the *retention;* and where care is taken to exclude this accident by aseptic catheterism, such decomposition of the urine can be obviated. But in other cases, there seems to be evidence that in spite of all such precautions, and at an early period after the spinal lesion, nephro-cystitis is set up, with subsequent decomposition of the urine: and this is then to be regarded as a trophic effect. These are the most common nutritive lesions; others less often met with are arthritis and unilateral acute bed-sore dependent upon an irritative lesion of the brain.

As in the case of the brain, injuries of the spinal cord may be attended with symptoms of irritation as well as of paralysis. These are *pain*, *hyperæsthesia*, *muscular spasm*, and *excessive reflex irritability*. Where these symptoms occur at and from the time of the injury, they indicate some irritation caused directly by the injury; this may be meningeal hæmorrhage, but it is more often some displacement of bone causing pressure upon a nerve in the intervertebral canal. Coming on at a late period, these symptoms point conclusively to inflammatory irritation; they are more marked in *meningitis* than in *myelitis*, while paralysis quickly results from the latter process. These inflammatory processes vary much in intensity, and often involve both the membranes and the spinal medulla, but the observation of the following signs will enable a diagnosis to be made.

When after an injury the patient experiences severe deep-seated pain in the spine, which shoots down the limbs and round the trunk, the pain being increased by movement, and with this the muscles whose nerves come off from the affected part of the cord are spasmodically contracted, the limbs being rigid, with occasional clonic spasms excited by contact or voluntary attempts at movement, while there is marked hyperæsthesia of the skin, *traumatic meningitis* is to be diagnosed.

When, on the other hand, the pain is less marked, and not increased by movement, but the limbs are paralysed and cold, and rapidly waste, the skin is insensitive, and the superficial and deep reflexes are lost, while bed-sores rapidly form, and the urine becomes putrid, the symptoms are due to *traumatic myelitis.* The chief feature is the paralysis both of voluntary motion, sensation, and reflex action; this is not produced instantaneously, as in crush of the cord; nor very quickly after the injury, as in hæmorrhage into the cord; but more slowly, after an interval to be measured by days, and there is accompanying it general fever, as in other inflammations. *Hæmorrhage into the meninges,* when extensive, may lead to compression of the cord, and so to paralysis; but from the large size of the cavity into which the blood is poured, the paralytic phenomena are gradually and not suddenly induced, while the paralysis *ascends*, affecting first the lower limbs and reflex centres, and gradually spreading upwards; this condition is to be distinguished from myelitis by the paralysis being less marked and complete, as well as by the period of onset and the absence of fever.

When at some interval from an injury the patient complains of pain in the spine, extending round the trunk and down the limbs, accompanied by spasmodic contractions of muscles and painful startings, and various alterations in sensation, numbness and formication, with increase of the reflexes, and these symptoms are gradually succeeded by motor and sensory palsy and loss of reflexes, which slowly creep higher and higher up, the phenomena are those of *chronic meningo-myelitis.*

2. **Injuries of the vertebræ.**—It must not be forgotten that some cases of sudden death from injury *are* due to crush of the upper part of the cervical *spinal cord from* fracture-dislocation of the bones, and

when an explanation of the death is not elsewhere found, this region should be carefully explored; very free mobility of the head, with or without crepitus, will further point to this injury.

Where the symptoms of paralysis coming on immediately upon the receipt of an injury to the spine point to crush of the spinal-cord, a *fracture-dislocation* of the bones opposite the injury to the cord, the upper part of the spine passing forward upon the lower, may be inferred. If the lesion be in the cervical or dorsal region, a thorough examination of the spine will not be justifiable, as the injury of the bone is unimportant compared with that of the spinal marrow, and the manipulations requisite to determine the state of the bones are attended with the danger of rendering the crush of the cord more extensive, and of exciting myelitis, which, spreading up, will cause still further and may be fatal paralysis. When, however, the injury is in the lumbar or sacral region, a careful examination of the spine should be made, for there we have the resistant cauda equina occupying the spinal canal; if any displacement of the bones is detected it will be justifiable to attempt its correction. In such a case, then, the patient should be carefully turned well over on to his side or even his face, and the surgeon should pass his fingers steadily down the vertebral spines to determine whether there is or is not any break or dip in their line; and if a marked deformity be detected, efforts may be made to replace the bones. It must be borne in mind that regularity of the line of the spines is no proof of the absence of fracture-dislocation in the face of evidence of crush of the cord or nerves, for the displacement of the bones may have been but momentary, or reduced by subsequent movements.

In cases, however, in which there is no evidence of crush of cord, but where a severe blow has been received on *the spine* directly, the examination may be made more deliberately. The patient standing up, the surgeon should examine the lines of the spines and transverse processes to determine whether there is any irregularity, depression or marked lateral deviation, at the injured part, and seizing the spinous processes between fingers and thumb, he should attempt to move each of them laterally to determine whether any one of them is detached.

It is in cases of injury to the cervical spine, and especially of the higher part of it, that the examination becomes most critical; where the cord is crushed the symptoms are unequivocal; but where there is, or is suspected to be, a fracture or a dislocation without crushing of the cord, a complete examination is precluded by the danger of its leading to further displacement with crushing of the cord, and sudden death or rapidly fatal paralysis. Such cases, then, are only to be investigated with the utmost gentleness; pain and rigidity are the symptoms suggesting such an injury, and where the face is turned to one side and fixed in that position, it points very strongly to dislocation forwards of a cervical vertebra on the opposite side. Subsequently, when ankylosis is obtained, the parts may be freely examined, and irregularity of the spines and transverse processes, with perhaps thickening from masses of callus, may confirm the previous diagnosis of a fracture.

Fracture and dislocation of the coccyx may be produced by direct violence, falls, kicks, and possibly also in parturition. There is great pain in walking, coughing, and defæcation, any act in which the muscles attached to the coccyx come into play. On examining the part externally, irregularity or crepitus may be detected; but if not the finger should be passed into the rectum and the anterior surface of the bone explored; if now a part of the bone be found movable *upon the rest*, with crepitus, it shows that the bone is fractured; while, if a marked transverse projection at the base of the bone is felt, it indicates a dislocation; it must then be noted whether the prominence is the lower end of the sacrum or the upper end of the coccyx, and this will decide whether the coccyx is dislocated backwards or forwards.

3. **Injuries of the ligaments and muscles** are often combined with the more serious lesions we have been considering above; but they are not unfrequent quite apart from them, as a result of sudden and violent twists, blows, and strains of the spine. They are the cause of pain and a certain amount of rigidity of the spine, which often lasts for some time, especially in the case of railway accidents.

Immediately after the accident the symptoms are localised pain and tenderness, with pain on attempting to move that part of the spine, and often some swelling and ecchymosis; neither irregularity nor mobility of the spines or transverse processes; no paralysis or hyperæsthesia of distant parts, unless there is also some lesion of the spinal medulla or nerves. It is, however, later on, when the first effects of the injury have been recovered from, and the pain continues, that the diagnosis becomes of most importance, and the surgeon has to determine whether there is a simple sprain of the muscles and ligaments of the spine or disease of the bodies of the vertebra, or chronic meningo-myelitis.

In any case where an action for damages is pending the examination must be made with the utmost care and circumspection, as the patient may under these circumstances be self-deceived, or malingering. The general appearance and behaviour of the patient should be carefully noticed, as well as his movements while his attention is diverted into some other channel.

In the absence of muscular spasms or paralysis, hyperæsthesia, paræsthesia, or anæsthesia, at a distance from the injured part, and of increased or diminished reflexes, *meningo-myelitis* may be excluded. If the pain have continued for many months and there be no projection of a spine or spines (angular kyphosis), and if there be a certain amount of movement of the vertebræ one on another, while pressure down the spine from the head or the shoulders does not excite severe pain, *caries of the spine* may be excluded. It must be remembered that caries of the spine may be set up by a sprain. If, in the absence of these signs, there be a localised pain in the back, made worse by movement, with some tenderness along the spines, or the muscles by the side of them, and limitation of movement owing to pain, a *sprain of the spine* may be diagnosed.

If the muscles are found wasted, and if the spine can be bent painlessly to a moderate degree, while the effort to straighten it causes pain referred to the attachments of the erector spinæ, the injury is mainly confined to that muscle. If, on the other hand, the muscles be found fairly well nourished, and the pain in moving the spine be not in straightening it, but in bending it beyond a certain slight extent, it points to sprain of the vertebral ligaments. A muscular sprain is recognised by the pain caused by the contraction of the muscle; a ligamentous sprain is characterised by the pain on stretching the ligament; it must, however, be noted that pain is caused when a sprained muscle is stretched to the full. Occasionally, after severe sprains of the spine, especially of the neck, as in other joints, the part is left too movable, the ligaments being loose and lengthened. A severe wrench of the spine without fracture or dislocation may be followed by hæmorrhage around the cord, or by suppuration in the spinal canal, and suppurative meningitis.

4. **Wounds of the spine.**—Mere skin or flesh wounds of this region do not present anything abnormal. If, however, a deep wound, such as a stab, be attended with a free flow of a clear watery fluid, it shows that the *theca vertebralis* is injured, and that the subarachnoid cavity is opened. For the chemical characters of this watery fluid, *see* page 83. Such an injury is likely to be followed by acute meningitis.

If a wound of the spine be immediately followed by paralysis of sensation or motion, it shows that the *spinal cord*, or one or more of the spinal nerves, is injured. The distribution of the paralysis will enable the observer to determine the nerve lesion; division of a nerve, causing paralysis of the parts supplied by that nerve without any effect upon the parts below; division of any part of the spinal cord paralysing all the parts below in those functions for which that particular section of the cord is a conductor. (*See also* page 99.) Wounds of the spinal cord are prone to excite myelitis.

CHAPTER VII.

THE DIAGNOSIS OF INJURIES OF THE FACE.

The greater number of the injuries of the face are too obvious in their nature to require notice here; but it may be pointed out that wounds must always be carefully examined for foreign bodies, that bruises must be examined for signs of fracture of the subjacent bone, and that the swelling following lacerations of tissue is often more marked in the face, particularly the lips and eyelids, than in other regions. When from a wound of the cheek there is a great flow of a watery fluid during mastication, the fluid being alkaline in reaction, and "amylolytic," or possessing the power of converting starch into sugar, it indicates a wound of the *parotid gland* or of *Steno's duct.* And if, when the rest of the wound heals up, a sinus remains which continues to discharge saliva, it is called a *salivary fistula.* The alkaline reaction of the fluid, and its intermittent flow, which is always excited by mastication, are usually alone relied upon to decide the nature of the fluid; but if, on adding some of the fluid to a small quantity of a watery decoction of starch, and maintaining it at a temperature of about 100° Fahr. for an hour, it be found that the addition of a drop of tincture of iodine fails to give the characteristic deep blue reaction, and that a brown colour is produced, or no effect at all, the diagnosis is rendered certain. If the wound or the fistula be behind the middle of the masseter muscle, the saliva is escaping from the parotid gland; but if in front of that line Steno's duct is wounded.

If, in addition to an ordinary bruise of the face, such as a "black-eye," there be a distinct swelling, circumscribed, prominent, fluctuating, and dull on percussion, it is a *hæmatoma.* Such a swelling may become solid from coagulation of the blood, or may suppurate.

If, immediately after a blow upon the nose, a smooth, tense, rounded, glossy purple swelling be found blocking up one nasal fossa and fixed to the septum of the nose, it is a *hæmatoma of the nasal septum.*

If after a blow upon the face there be a puffy swelling, soft, crackling under the fingers, resonant on gentle percussion, it is due to *emphysema*, and indicates a fracture extending into one of the air-containing cavities of the face. The position of the earliest swelling will indicate whether the fracture is into the frontal sinus, the nose, or the antrum.

For the detection of *fractures* of the facial bones, *each bone should* be carefully examined to determine whether there is any marked deformity. Thus, run the forefinger along the bridge of the nose to see if there be any sharp break in it; then, in the same manner, with the two forefingers examine the sides of the nasal bones and the nasal processes of the superior maxillæ; to deformity may be added mobility and crepitus, and in that case there can be no doubt in the diagnosis; the point or line of deformity and mobility will determine the position of the fracture. Then examine the upper row of teeth and the alveolar process, see if its line is unbroken, and if any part of it can be moved; with the eye and finger examine the hard palate to determine that it is regular and symmetrical, and that the two halves are not separated. Then throw back the patient's head, and gently everting the nostril, examine the septum nasi on each side; it may be found fractured and displaced vertically or laterally, with depression of the tip of the nose. But care must be taken not to mistake a natural deflection of the septum for a fracture in it; when the mucous membrane over the septum is unaltered in colour and not swelled, the curvature not tender, and there is no unwonted obstruction to the passage of air along the nose, it may be considered a natural deflection of the septum; but when, on the other hand, the curvature is abrupt, the part swelled, discoloured and tender, and there is unwonted obstruction to nasal respiration, along with flattening or deflection of the nose, it must be regarded as a fracture. Then compare the two malar bones and note any irregularity, flattening, or mobility of the one struck; and from these pass the fingers back along the zygomatic arches to determine whether either is broken across, which will be indicated by irregularity of the bone and mobility of the fragment. In some cases the fracture of the bones of the face is so extensive that the fragments can be seen and felt to move with the utmost ease; in other cases again there is so much swelling and bruising of the soft parts that a thorough examination and diagnosis cannot be made until after the lapse of a few days.

The lower jaw must be examined in a similar manner. The surgeon should first run his fingers along the outer and under-surface of the body of the bone to detect any irregularity or want of symmetry of the two sides. Then let him look at the line of the teeth, and if any irregularity in it be seen, let him grasp the bone, with one hand on each side of the deformity, and try whether there be mobility and crepitus, and note whether the fracture extend through the alveolar process alone or through the body of the bone as well. If the fracture be opposite or behind the canine tooth, the sensibility of the lower lip on the same side should be tested, to ascertain whether there is also injury of the inferior dental nerve. The surgeon should carefully note whether all the teeth are in place, and if not, he should make sure that one has not slipped down between the fragments. The ramus of the bone must then be carefully examined; by seizing the angle mobility can be tried for, the contour of the posterior border as well as of the surface through the masseter muscle should be determined. Should these parts be sound and yet the patient complain of great pain in opening and closing the mouth, while he can himself feel and hear crepitus, the coronoid and articular processes should be carefully examined. Place the forefingers, one immediately in front of each pinna, to feel the condyles in their normal position, and carefully compare them to make certain whether they are or are not symmetrical, and look closely at the position of the chin, noting whether the space betwen the lower central incisor teeth is vertically below that between the upper; should there be deformity of one condyle, while the chin is displaced to the same side, a fracture of the neck of the jaw on that side is to be diagnosed. The coronoid process is to be explored by the finger in the mouth, which may detect that it is immovable, or that it is movable on the rest of the bone, and sometimes a sharp projecting edge or point of the fracture can be detected.

If, however, on placing the finger immediately in front of the tragus, the firm, slightly projecting condyle of the lower jaw is not to be detected, but, on the contrary, a hollow (the glenoid fossa) is felt, while there is a fulness of the temporal fossa just above the zygoma, there is a *dislocation of the jaw.* This may be *unilateral*, in which case the chin is displaced to the opposite side, or *bilateral*, when the mouth is open and the chin protruded, and there will be the usual signs of pain, with dribbling of saliva, and pain in speaking or attempting to swallow.

CHAPTER VIII.

THE DIAGNOSIS OF INJURIES OF THE NECK.

THE injuries of this region may be divided into wounds, contusions, the impaction of foreign bodies in the respiratory or alimentary passages, and the local effects of heat and caustics. Sprains and fracture and dislocation of the cervical spine have been considered under the head of *injuries of the spine* (chapter vi.).

Wounds of the neck, inflicted from the outside, are, of course, obvious, but they vary from the most trivial, through all grades up to those which are almost instantly fatal, and it is necessary both for purposes of prognosis and treatment, to determine what parts have been severed. The question of primary interest is that of wounds of vessels and hæmorrhage, and the ordinary rules will here guide the surgeon; the main vessels lie so deeply that they are comparatively rarely severed. If the wound is in front above the hyoid bone, the *tongue* may be implicated. An incision in the thyro-hyoid space may sever the *epiglottis*, and so open into the *pharynx.* Wounds opposite the thyroid cartilage, and severing that structure, may traverse the larynx above, at the level of, or below the *rima glottidis.* Still lower down, the *crico-thyroid membrane*, or the *trachea*, may be implicated. A wound of the *air-passage* will be shown by the escape of air from the wound, and oftentimes also by the escape of mucus and frothy blood, and by the loss of voice. The *pharynx* is readily opened through the thyro-hyoid space; but below that, it and the gullet can only be injured by a wound on the front of the neck if it have first completely severed the larynx or trachea; where the wound is thus very deep it may in some instances be obvious that the alimentary canal is opened or severed; but where there is doubt it may be cleared up by passing a soft catheter or œsophageal tube through the mouth, and observing whether it be visible through the wound; the surgeon should not give the patient food to swallow to see if it escape through the wound in the neck, as it may pass into the air-passages, and do serious harm; and only when he is assured that the pharynx or œsophagus is not wounded should he allow the patient to eat or drink.

In cases of *gunshot wound or stab* in the neck, where the injured parts cannot be so well and so easily explored, the diagnosis has to be more largely inferential. If a soft, puffy, crackling swelling forms, which increases on attempts at coughing, it is evidently subcutaneous emphysema from *wound of the air passage;* such a wound is also to be diagnosed if the *patient* cough up frothy blood. A stab or gunshot *wound of the œsophagus* may pass unnoticed; but if the patient vomit blood, or if deglutition be very difficult or painful, and especially if on drinking some milk some of the fluid appear at the external wound, such an injury is to be diagnosed. *Injury of the nerves* of the neck will be shown by limited paralysis; in the posterior triangle the great cords of the brachial plexus may be severed, and there will then be motor and sensory paralysis of parts of the upper limb; or the phrenic nerve may be injured as it lies on the scalenus anticus, this will be shown by paralysis of the diaphragm, causing difficulty in taking a full inspiration, and inability to force down the abdominal viscera, and protrude the belly-wall fully on the same side. If, after such a wound in the neck, the pulse be found irregular and quick, and the action of the heart turbulent, it would point to injury of the vagus nerve; while if the pupil on the same side be small, and do not dilate when both eyes are shaded, it would indicate an injury of the cervical sympathetic. If there be loss of voice or dyspnœa, not otherwise explained, the larynx should be carefully examined with a laryngoscope, and if one of the cords be found in the cadaveric position, and unmoved when the patient attempts phonation, or takes a deep inspiration, paralysis of the muscles of that side of the larynx from division of the recurrent laryngeal nerve must be diagnosed.

In regard to *wounds inflicted from the inside*, it only needs to be pointed out that an exact diagnosis may be quite impossible; hæmorrhage may show that a vessel has been wounded, but there may be nothing to indicate what particular vessel is injured, especially where the wound is out of sight.

Contusions of the neck may be instantly fatal. Where this is not the case the examination should be conducted with the view of determining whether the *hyoid bone*, or any of the cartilages of the larynx or the trachea, have been injured. The arch of the hyoid bone should first be examined to see if there is any irregularity in it, or whether on compressing the two cornua crepitus is obtained, or great pain caused, or whether the bone yields with the normal elasticity; where the bone is broken there is usually great pain in deglutition and in any movement of the tongue, so that speech is difficult and painful; there is also inability to turn the head, and on looking into the mouth ecchymosis of the mucous membrane may be observed. Dislocation of the hyoid bone, in which the cornu of the bone catches against the cornu of the thyroid cartilage, has already been described.

Next examine the *cartilages of the larynx*, and if they be found flattened, or the pomum Adami displaced to one side, or unduly movable, or there be distinct crepitus, a fracture of one or other of these cartilages may be diagnosed. There may be so much swelling from effused blood or from emphysema that no precise diagnosis may be possible. The symptoms may be nil or very severe—dyspnœa, cough, and pain.

The *trachea* is very rarely ruptured; but if after a blow on the lower part of the front of the neck there be severe dyspnœa, with cold, livid countenance, weak or lost voice, emphysema of the neck, and the larynx can be felt to be normal, this injury may be suspected, and the diagnosis will be established if the state of the patient and of the parts permit of an examination of the trachea by the finger, and a gap be found in its continuity.

CHAPTER IX.

THE DIAGNOSIS OF FOREIGN BODIES IN THE PHARYNX, ŒSOPHAGUS, AND AIR PASSAGES.

Cases in which foreign bodies have passed from the mouth, and in some instances from the stomach, into the œsophagus or air passages often present great difficulties in diagnosis, while they are never without grave importance. They naturally divide themselves into two groups: one, in which there is a distinct history pointing to such an accident, and the other, in which no such history is forthcoming, and in which the surgeon has to trust alone to the result of his examination; these latter cases may be very obscure. The *history* that may be volunteered, or that should be inquired for, is that of a sudden inspiration or effort while food or some other substance is in the mouth or held between the lips, of vomiting, or of hurried swallowing of only partially masticated food, etc., followed immediately, even suddenly, by symptoms of obstruction to respiration, to deglutition, or to both. In young children there may be an entire absence of history, or it may be known only that the child had something in its mouth when the symptoms suddenly supervened, and if it be cherries or plums that the child was eating, the fact becomes additionally significant. In older persons the symptoms may come on during sleep, from the slipping of a plate of artificial teeth, and the surgeon in any case of sudden symptoms of obstruction should satisfy himself that this accident has not happened. In vomiting during unconsciousness from alcohol, chloroform, etc., some of the vomited matters may *pass into the* air passages.

In addition to these positive facts, there are some of a negative character that may be of use; these are the absence of fever, of any previous cough, of change of voice or dyspnœa, and of membranous pharyngitis; in this way croup can be excluded.

The symptoms vary within a very wide range. They may be constant or intermittent, threatening and even causing instant death, or slight and continuing for months or years. They may be enumerated as pain and difficulty in deglutition, pain and difficulty in respiration, spasmodic attacks of coughing, loss or change of voice, obstruction to the entrance of air into a part or the whole of one lung, purulent expectoration, etc. The chief characteristic is the sudden abrupt onset of the symptoms.

The diagnosis.—In cases of extreme urgency, with sudden dyspnœa threatening life, and aphonia, the surgeon will at once thrust his finger to the back of the mouth to feel for and to dislodge any body that may be over or in the upper orifice of the larynx, and failing this will proceed to open the larynx or trachea, without waiting to make an exact diagnosis of the cause and actual position of the obstruction.

In cases of less urgency, where there is time for deliberation, the first step in the diagnosis is to determine whether the foreign body be present in the air or the food passage. For this purpose give the patient some water to swallow, and if that be taken easily then try some bread, and if a bolus of bread be swallowed without difficulty or pain it may be concluded that the pharynx and œsophagus are free. If the result of the trial is inconclusive, an œsophageal bougie or probang may be passed, which will at once determine the presence or absence of obstruction in that tube.

Foreign bodies in pharynx or œsophagus.—*The usual mode* of procedure is for the surgeon to pass his right forefinger into the pharynx, and with it to explore the fauces, tonsils, upper orifice of larynx, and as far down the pharynx as he can reach; in many cases this will suffice to determine the presence and position, and even to dislodge a foreign body; but it is imperfect in result, and disagreeable to the patient. A better plan is to trust to the eye. With the mirror used for the laryngoscope throw a strong light into the pharynx, and explore it well, then introduce the laryngeal mirror, and with it examine the upper orifice of the larynx, base of tongue, and lower part of pharynx. Should the obstruction or impaction be below this, as it usually is, the œsophagoscope, an instrument which as yet has been but little used, may be passed, and the lower end of the pharynx and the œsophagus explored, or an ivory-ended probang on a whalebone stem may be slowly and gently passed down into the stomach; one of full size should be chosen. With this a foreign body of any but a small size may be felt, and if thought desirable, may be pushed on into the stomach. Pins and small fish-bones, however, will not be thus detected. For them it is best to use an "umbrella probang," by which they may be removed. If, however, after repeated trials, nothing be removed, and the patient complain of a pricking pain in a part beyond the reach of the eye or finger, it is a difficult matter to determine whether the symptoms are due to a sharp body actually impacted, or to a scratch or abrasion made by such on its way to the stomach, which often feels to the patient during swallowing like a sharp prick. Time will help most of all in clearing up the matter, for if it be an abrasion or wound of the gullet, and only soft food be taken and be carefully swallowed, the pain will gradually and quickly subside; whereas if the foreign body be still impacted, the pain will continue, and the patient may hawk up a little blood and pus. It is oftentimes a very difficult matter for the surgeon to assure himself or the patient that some small sharp body is not really impacted in the gullet. (*See* page 18.)

When large bodies, such as a set of false teeth, are impacted in the lower part of the pharynx or upper part of the gullet, they may be plainly felt in the neck, bulging out the wall of the tube behind the larynx or trachea.

Foreign bodies in the air passages.—If the symptoms to which reference has already been made lead to the belief that there is or may be a foreign body in the air passages, the case becomes one of grave importance, demanding a most careful examination. It must be remembered that while such an accident may induce the most distressing and alarming or even quickly fatal symptoms, in other cases the symptoms may be very slight, and further, that, having been severe at first they may quickly subside and give the impression that the foreign body has been expelled: this latency of symptoms must not deceive the surgeon.

The evidence on which reliance must be placed is that which shows the actual seat of the foreign body, rather than the general symptoms of the ingress of some solid substance. The examination, whenever possible, should be systematic. *First examine the larynx*, note the voice, the character of the dyspnœa and cough, and whether there is any local pain or tenderness; but reliance must be placed chiefly on the results of a careful laryngoscopical examination, which should be as thorough and systematic as possible, the observer first exploring the ventricles and the parts above the rima glottidis, then the rima, and subsequently the parts below the cords. Should the body be very small, as, for example, a pin which has transfixed the tissues, and has become almost entirely buried in them, it may be overlooked if great caution *be not exercised.* In favourable cases the *trachea* can be examined in the same way, and any foreign body in it seen; in other cases, however, we have to rely rather upon symptoms; if attacks of severe spasmodic dyspnœa recur from time to time as the result of a cough or effort, and the patient feel something moving in his trachea, and even perhaps striking the cords above, and still more if on ausculting over the front of the neck the foreign body be heard moving up and down in the trachea with respiration, we are justified in diagnosing the presence of a body which lies loosely in the trachea, and is occasionally forced up violently against the cords, exciting intense spasm of the glottis-closers. Should the trachea be found free, *the lungs* must be carefully examined, attention being directed to the expansion of the two sides respectively, and to the results of percussion and auscultation. Should one side of the chest be found immovable during respiration, while the opposite side moves excessively, and the immovable side be found to yield a resonant percussion note, the opposite side being hyper-resonant, and on ausculting the chest there be an absence of vesicular murmur over the one side, or a loud musical or sibilant râle, loudest over the root of the lung, while on the opposite side the breath sound is exaggerated, and without râle unless that on the immovable side be conducted across; if these signs are made out, there can be no hesitation in diagnosing the impaction of some foreign body in the bronchus of the side on which the chest is immovable. It should be remembered that in such cases there may be no dyspnœa or distress while the patient is quiet, but movement will at once be attended with dyspnœa. Should an absence of breath sounds or a loud sonorous or sibilant râle be detected over only a part of one lung, the symptoms may be attributed to the impaction of a foreign body in one of the secondary or tertiary bronchial tubes. In some cases a diagnosis has only been made, and has only seemed to be possible, when the foreign body has been actually extruded, either through the mouth or through an abscess in the chest walls.

Cases where foreign bodies have lodged for some time, and have set up suppuration, will probably be overlooked unless the history of the onset of the affection be elicited; unusual localisation or exact limitation of the physical signs, however, should always suggest inquiry as to the possibility of the cause being an impacted foreign body.

There are other cases of injury from foreign bodies getting into the air passages or gullet, viz those due to hot liquids or caustics. In either case the lips, mouth, and tongue may show signs of scalding, or of the caustic effects of acids or alkalies or of carbolic acid. But in other instances the rapid onset of laryngeal obstruction in a child who has shown no previous symptoms is the first and only evidence of the *scald of the larynx.*

CHAPTER X.

THE DIAGNOSIS OF INJURIES OF THE CHEST.

INJURIES of the chest are of very frequent occurrence, and from the great importance of the contained viscera they are of special practical interest. They may be classified into *contusions* and *wounds,* which will be separately considered; and as the sequelæ of these two groups of injuries are to some extent the same, only the immediate and direct effects of contusions and wounds will be considered at first, and in *a concluding section* of the chapter, the diagnosis of all the sequelæ or secondary complications of chest injuries will be given. Many of these latter are inflammatory affections, which, when idiopathic, come under the care of physicians, and much fuller information concerning them will be found in works on medicine.

A. **Contusions.**—A patient having received a contusion of the chest, the diagnosis may be best arrived at by the surgeon's attempting to answer the following five questions:

(1) **Is there a bruise?**—The presence or absence of the well-known ecchymotic discoloration will decide this point. If a purple or yellowish stain appear in the skin after an interval of a few days, it indicates a deep bruise; ecchymosis and blood-staining of the skin or loin appearing after two or more days have been said to be pathognomonic of hæmothorax, but reliance must not be placed on this sign, as blood in the pleural cavity does not always cause ecchymosis in the loins. The extent of the bruise is, of course, an indication of the number and size of the vessels which have been torn, or of hæmophilia.

(2) **Is there rupture of a muscle?**—From a blow or sudden severe strain there may be more or less extensive rupture of a chest muscle, especially of the pectoralis major. If there be inability to raise the arm in front of the body, while on the patient's making the attempt to do this a gap is seen or felt in the pectoral muscle, this lesion is to be at once diagnosed. Similarly, a gap in any other muscle, with pain, and inability to contract the muscle effectively, may enable the diagnosis of ruptures of other muscles to be made.

If contraction of a muscle cause acute pain, and no fracture be present, and pressure on the painful part elicit tenderness, *bruise of the muscle*, with slight rupture, is the probable lesion. The pain of this injury may continue for some time, and when it implicates the intercostal muscles, the symptoms simulate those of broken rib, as there is pain with all the respiratory movements, and some local tenderness; but the diagnosis is established by recognising the absence of irregularity in the rib, of crepitus or of mobility, by failure to elicit pain by pressure on the rib at a distance from the tender spot, and by the absence of local emphysema.

(3) **Is there a swelling over the ribs?**—The eye, and especially the hand placed flat upon the chest, will decide this question at once. Such a swelling may be due to

(*a*) *Hæmatoma*; blood outside the chest.

(*b*) *Emphysema*; extravasation of air in the cellular tissue.

(*c*) *Pneumatocele*; hernia of the lung.

(*a*) Notice whether the swelling be well defined, whether it fluctuate or not, if it pit on pressure, or give a soft, crackling sensation to the fingers, whether it be resonant or dull on very light percussion, and whether it vary in size with inspiration, expiration, and coughing. If it fluctuate, or if without fluctuation it be ill-defined, dull on very superficial percussion, unvarying in size with respiration, and non-crepitant, it is a *hæmatoma*. These collections of blood vary much in size; if large and quickly formed, they are due to the rupture of a large vessel, such, for instance, as an intercostal artery near the spine, or a large thoracic branch of the axillary trunk. Hæmatoma will be distinguished from abscess by its early appearance after the injury, and the absence of the usual signs of acute inflammation.

(*b*) If the swelling be ill defined, gradually extending, soft, even pitting on pressure, crepitant, resonant on very superficial percussion, and either unaffected by deep respiration, or if increased by a deep expiration or a cough not lessened by a deep inspiration, it is *subcutaneous emphysema*, air having escaped from the lung into the cellular tissue of the chest-wall. This may arise in one of three ways: (α) the lung may be ruptured by severe pressure upon the chest while the glottis is closed, the air passing under the pleura to the root of the lung, and thence spreading up to the neck and over the chest; in this case the swelling is first noticed about the neck and at the back, and not at a point which is the seat of considerable pain; (β) or a fragment of a broken rib may lacerate the subjacent lung, and the air escape into the pleural cavity (pneumothorax), and thence at each expiration into the superficial cellular tissue; (γ) or should the fracture occur at the seat of an old pleuritic adhesion, the air passes into the subcutaneous tissue without previously filling the pleural cavity. In either of these latter cases the emphysematous swelling appears first over the broken rib, at the seat of an acute stabbing pain, and not at the neck or back. In the one case there will be great dyspnœa, displacement of the heart, absence of breath-sounds, or amphoric respiration, with metallic tinkling, indicating the presence of *pneumothorax;* while in the other case, the vesicular murmur will be plainly audible and quite superficial all over the chest. In either case the presence of this local form of emphysema indicates a fracture of a rib, with wound of the lung. The surgeon must not be misled to the diagnosis of pneumothorax by the existence of a tympanitic percussion note, as the presence of air in the superficial tissues may give that sign.

(*c*) If the swelling be clearly defined in outline, soft, non-crepitant, resonant on percussion, swelling out on expiration or coughing (which latter gives a distinct "impulse" to it), and sinking during a deep inspiration, it is a *pneumatocele* or hernia of lung, and indicates an extensive and serious lesion of the wall of the chest permitting of the protrusion of the lung. This is a very rare complication of contusions, but is a more frequent attendant upon wounds of the chest.

(4) **Is there an injury (fracture or dislocation) of the bony and cartilaginous wall of the chest?**—(*a*) After viewing the chest carefully, to discover whether there is any obvious deformity, and whether the respiratory movements are general, uniform, and free, pass the hand down the sternum, and then along the ribs from before back, in order from above down, and notice whether there be any irregularity, depression or projection, in them; at the same time any local tenderness will be detected. If there be an abrupt sharp projection across the sternum, the projecting edge being continuous with one part of the bone, usually the upper, it will be from a *fracture of the sternum*, in which the lower fragment is generally displaced backwards beneath the upper. Should the projection be opposite the second costal cartilage, it will be from a *separation of the manubrium from the gladiolus.* Care must be taken not to mistake the normal slight ridge across the bone at this level, which is smoother and more even than in fracture or dislocation; nor the smooth depressions sometimes met with in the lower part of the bone, which have no sharp angles or ridges about them. If there be no local bruising occasioning pain, tenderness, and considerable swelling, such a mistake should hardly be possible.

Similarly an irregularity in the line of a *rib cartilage* may indicate its *fracture*, or a projection where the rib joins the cartilage may show a *separation of the rib from its cartilage;* care must be taken not to mistake for this the nodular enlargement of this part, so common in rickets; the diagnosis will be easily made by noticing that the rickety swelling is symmetrical, affects many of the ribs, and is smooth and rounded, while the projection from dislocation affects only one or two ribs, is more marked and irregular, and mobility may be detected between the two parts.

A marked depression, or angular projection, in the course of a rib or ribs may clearly establish the presence of *fracture of ribs.*

(*b*) Should the result of the above be negative, place the hand firmly over the part where the patient experiences pain, and induce him to breathe deeply, and then to cough; should crepitus be felt, it will determine the existence of a *fracture.* Some prefer to place a stethoscope over the most painful part, and to listen for crepitus during movements of the chest.

(*c*) Should this yield only negative evidence, with one hand over the suspected region, make firm pressure with the other hand along the ribs and over the sternum; in this way crepitus may be elicited; or if it be found that firm pressure on a rib causes a sharp pain at a distance from the point pressed upon, that may be taken as evidence of a *fracture.*

(*d*) It has already been pointed out that the presence of local emphysema or of a pneumatocele proves a *fracture of ribs.*

(*e*) In some cases the patient is able to give a clear history of hearing and feeling a bone snap at the time of the accident, and of feeling a grating sensation on taking a full breath; the sharp stabbing pain will always enable him to localise exactly the position of a *fracture.*

(*f*) The surgeon may be unable to detect any irregularity of a rib, or to elicit crepitus; in such a case, localised sharp pricking or stabbing pain caused by any attempt to take a deep breath or to cough, and by pressure upon the rib at a distance, with spontaneous fixation of that part of the chest, will be the signs upon which the diagnosis of *fracture* will have to rest.

(5) **Is there a lesion of the thoracic viscera?**—Cases of extensive laceration of the lung with laceration of large vessels, of double pneumothorax, or of rupture of the heart or great vessels, are usually speedily fatal, death occurring before any exact diagnosis can be made.

The observer should look for signs of shock, or of loss of blood (pallor, coldness of the surface, syncope), and should notice the amount of dyspnœa present, as each and all of these signs are important as indicating that the injury is not a simple contusion of the chest-walls, but is complicated with some more serious condition. There are two phenomena which at once enable a diagnosis of *injury of the lung* to be made, and they may, therefore be at once alluded to. One is *subcutaneous emphysema*, showing that a rupture or wound of the lung has been produced, allowing air to escape from the alveoli. The other is *hæmoptysis;* if bright-red, frothy blood be coughed up, it proves beyond all doubt a lesion of some of the pulmonary vessels, the blood escaping into the bronchi; the amount of the hæmorrhage will be some guide as to the extent of the lesion in the lung or the size of the injured vessel.

It may be pointed out here that in some cases a patient will cough up sooty or black sputa a few days after an injury to the chest; this arises from a small *bruise of the lung*, with hæmorrhage into the alveoli, the altered blood only passing slowly into the bronchi, and being expectorated after an interval.

The chest must then be examined thoroughly; the relative size and amount of expansion of the two sides being first noted, then the percussion-note, the respiratory murmur, voice sounds, position of the heart's impulse, and character of the heart sounds. This examination is to be conducted to enable the surgeon to determine whether there is air or fluid in the pleural cavity, laceration of the lung, or deranged action of the heart.

If there be normal resonance all over the pulmonary area, with superficial vesicular respiratory murmur everywhere without râle, and normal voice sounds, with a regular action of the heart, and normal heart-sounds, the surgeon will be justified in deciding against any lesion of the lung or heart in the absence of any positive sign to the contrary, such as emphysema. If shortly after an accident the lower part of the pulmonary area be found to be dull on percussion, the dulness perhaps increasing in extent from hour to hour for a few hours, and over this area the vocal fremitus be weakened or abolished, while auscultation shows the respiratory murmur and vocal resonance to be weak and distant, or absent altogether; and immediately above the dull area the physical signs are normal or indicate compression of the lung, a diagnosis of *hæmothorax* is to be made. If there be much pleural hæmorrhage there will be a corresponding degree of dyspnœa, and the usual signs of loss of blood. After two or three days a dark purple discoloration of the skin over the lower part of the chest behind and in the loins may be noted. The blood will almost certainly come from the lung, and its presence may be accepted as a proof of *laceration of the lung;* where there is also hæmoptysis, this fact is beyond all doubt.

If one side of the chest is found to be expanded with obliteration of the depressions along the intercostal spaces, giving a tympanitic percussion note, the breath-sound being weak, and distant, or inaudible, or amphoric in character with perhaps coarse, crepitant râles, "metallic tinkling" and the "bell-sound" being audible, while the heart is found displaced to the opposite side, and the patient experiences severe dyspnœa or even orthopnœa, it indicates pneumothorax from *rupture of the lung* through the pleura, the air having escaped into the general pleural cavity; this may or may not be combined with fracture of a rib, or with superficial emphysema. Occurring on the left side it may obliterate the normal cardiac dulness, and so displace that viscus as to render detection of the cardiac impulse impossible, and that of the heart sounds very difficult. These signs may be present over a limited area of one side of the chest, the physical signs over the rest of the lung being normal; in that case there is a pneumothorax limited by old pleuritic adhesions.

If a combination of these physical signs be met with, a dull note and loss of voice and breath sound, and of vocal fremitus over the extreme base of the chest, and tympanitic resonance, amphoric respiration, "metallic tinkle," and succussion fremitus over the upper part of the chest, it shows that there is *hæmo-pneumothorax.* In all cases of pneumothorax there will be some amount of blood in the pleural cavity, but it may be so small in quantity as not to give rise to any characteristic physical signs.

In reference to the evidence of pulmonary lesions it may be well to draw the student's attention to the great importance of observing whether a patient the subject of fractured ribs be also the subject of emphysema of the lungs and chronic bronchitis, the barrel-shaped chest, loss of power of expansion of the chest in inspiration, prolonged wheezing expiration, hyper-resonance, diminution of the area of cardiac dulness, prolonged expiratory murmur, and loud sonorous or sibilant râles will be the signs pointing to these conditions, which render serious an accident under other circumstances of small moment.

Lesions of the heart from contusions of the chest are much less common than those of the lung. If, however, immediately after such an injury a murmur be detected in connection with either of the heart sounds, and there be evidence that this is a sequel of the accident, either by the surgeon's previous knowledge of the patient or the onset from the time of the accident of marked signs of disturbance of the circulation, which find no other explanation, and are explicable upon the theory of interference with the functions of one or other of the cardiac valves, it would be proper to diagnose a *rupture of a semilunar valve, or of chordæ tendineæ.* The signs of circulatory disturbance to be sought in such cases are faintness, a quick, feeble, soft pulse, or the suddenly collapsing pulse of aortic regurgitation, irregular and turbulent action of the heart, palpitation, dyspnœa, venous distension, and the signs of general pulmonary hyperæmia. For fuller information on these subjects reference must be made to works on medicine.

Ruptures of the large vessels of the thorax are very rarely caused by contusions of the chest, and are very rapidly fatal from internal hæmorrhage.

Injuries of the abdominal viscera are treated in chapter xi.

B. **Wounds.**—Wounds of the chest are of much less frequent occurrence than contusions, and they are usually produced either by stabs or bullets, and therefore they often have a medico-legal as well as a surgical importance. In any given case the surgeon should put to himself and seek an answer to four questions, and we may discuss the diagnosis in the form of answers to these questions.

(1) **Is the wound penetrating or non-penetrating.**— That is, is it limited to the chest walls? or does it extend into one of the three great serous cavities of the chest or into the mediastinum? The surgeon should attempt to show that it is penetrating, and only in the absence of all evidence to the contrary consider it non-penetrating; but in no

case must the wound be explored for this purpose, either by finger or probe, for in so doing penetration may be caused; reliance must be placed upon evidence of lesion of the thoracic contents. In some cases the wound is evidently quite superficial, and the question of penetration can hardly be said to arise.

If there be no emphysema around the wound, no passage of air through it during respiration (traumatopnœa), no pneumothorax, hæmothorax, or prolapse of lung, no hæmoptysis, no disordered action of the heart, and no dysphagia, there is no evidence to warrant the diagnosis of penetration; but even in these circumstances, when the nature of the injury makes penetration probable, it is only when no secondary inflammatory complications (pleurisy, pneumonia, pericarditis, or mediastinal suppuration) arise that an absolute diagnosis of *non-penetration* can be made.

(2) **Is the wound attended with hæmorrhage? If so, what is the source of the bleeding?**—Blood may escape externally through the wound, or be coughed up mixed more or less thoroughly with air, and in either case its recognition is perfectly simple. But the bleeding may be internal and unrecognised unless a careful examination is made. The constitutional signs of loss of blood (pallor, vertigo, syncope) must be carefully noted, and search should be made for evidence of hæmothorax, hæmopericardium, and hæmomediastinum. The signs of *hæmothorax* have been given already. (*See* page 131.) If, quickly after a wound, the normal cardiac dulness be increased, the impulse of the heart displaced upwards or lost, the sounds indistinct or inaudible, especially over the lower part of the dull area, with feeble or turbulent action of the heart as shown by the pulse, *hæmopericardium* may be diagnosed. If, with a sense of oppression across the chest and dyspnœa, there be found dulness behind the sternum and reaching outwards on each side, with loss of cardiac

impulse, and extreme weakness of the heart sounds, which may be entirely inaudible, *hæmomediastinum* may be diagnosed. These last two conditions may coexist, or the distinction between them may be very difficult; the position and known direction of the wound may afford some aid in diagnosis; blood in the pericardium leads to much more serious disturbance of the heart's action than when it is extravasated in the mediastinum. It must be remembered that external and internal hæmorrhage may and often do coexist, and although in all cases a careful examination to detect the latter should be made, the necessity for it becomes more urgent when the general signs of loss of blood are greater than can be accounted for by the external flow. Such examination must, however, be conducted with the greatest care, as undue movement or excitement of the patient may lead to a recurrence of hæmorrhage which has been arrested by nature.

The fact of hæmorrhage being established, some attempt must be made to determine its source. The position of the wound, and of the accumulated or flowing blood, are important aids in arriving at a conclusion. The intercostal vessels run along the lower border of the ribs; the internal mammary vessels run vertically down behind the costal cartilages, half an inch from the edge of the sternum; wounds therefore in these situations may involve those vessels, and if the bleeding be solely external, or escapes per saltum, or be moderate in amount, and the blood escape unmixed with air, and if on introducing a folded card into the wound the blood flow over the outside of the card and not within the fold, or if the bleeding can be stopped by pressure with the finger against the upper of the ribs bounding the wound, the hæmorrhage may be considered as coming from a *parietal vessel.* But when the hæmorrhage is excessive, and gives rise to hæmothorax, or when it is thin, of a bright red colour, and mixed with air, while similar blood is expectorated; especially if the blood-flow varies with respiration, and is attended with traumatopnœa or extensive emphysema, it may be regarded as coming from the *lung*. Extensive hæmorrhage from a wound over the area occupied by the heart and great vessels from a wound of those structures is attended with hæmorrhage into the pericardium or mediastinum, and is quickly fatal. The position and direction of the wound may enable the distinction to be made between wound of the heart and wound of one of the great vessels. It must be added that the diagnosis between parietal and visceral hæmorrhages may be impossible without exploration of the wound, and also that they may coexist.

(3) **Does the wound implicate a viscus?**—This is the most important question in reference to wounds of the chest, as upon the correct answer to it the prognosis mainly depends.

(*a*) If a wound of the chest be attended with moderate emphysema, or slight traumatopnœa or pneumothorax and collapse of lung, and there be no evidence of external hæmorrhage more than that accounted for by the external wound, and no hæmothorax, and no hæmoptysis, the diagnosis of *wound of the pleura* without injury of the lung is to be made; this lesion is rare, and is met with towards the extreme base of the lung, and as a result of wounds by not very sharp instruments.

(*b*) If instantly or quickly following a wound of the chest, a soft, smooth, dark purple mass be found projecting from the wound, elastic and crepitant to the fingers, it is a *hernia of the lung* due to a *wound of the pleura*. This is met with especially in wounds of the front of the chest, near the fissures of the lungs. The appearance and feel of the lung are characteristic, but a protrusion of very congested omentum has been mistaken for the lung, a mistake which may be avoided by noticing the lobulated condition of the omentum, and the smoothness and crepitation of the lung.

(*c*) Where there is extensive emphysema complicating a wound, or marked pneumothorax, hæmothorax, free hæmoptysis, or distinct traumatopnœa, and especially where two or more of these are met with together, a *wound of lung* is to be diagnosed.

(*d*) If a wound over the region of the heart be followed by tympanitic resonance over the cardiac area, with (sometimes without) a loud ringing character of the heart sounds, and if after a short interval there be dulness over more or less of the lower part of the cardiac area, with a tympanitic note above, a raised position of the heart's impulse, dyspnœa, distress, epigastric pain and quickened feeble pulse, followed in a few hours by pericardial friction, the evidence warrants the diagnosis of *wound of the pericardium*, leading to *pneumopericardium*, *hæmopericardium* and *pericarditis*.

(*e*) If a wound over the heart be immediately followed by considerable shock and syncope, with free external bleeding, or evidence of internal bleeding into the mediastinum or pericardium, with rapid weak pulse, and be quickly followed by the usual signs of pericarditis, a diagnosis of *wound of the heart* should be made. Should a foreign body be found in the wound, such as a long needle, and it be noticed to move with every pulsation of the heart, it may be assumed that it is embedded in the heart wall. There is often considerable anxiety and fear in cases of wound of the heart; they may be extremely difficult to diagnose, and some reliance must be placed upon the nature of the injury, the hæmorrhage and the early onset of pericarditis. The position of the wound will enable the surgeon to determine approximately which part of the heart is wounded.

(*f*) A wound over the great thoracic blood vessels, followed by profuse hæmorrhage and all the signs of extensive *hæmomediastinum*, with collapse, syncope, and dyspnœa, is complicated with *wound of a great blood-vessel;* such injuries are with few exceptions certainly fatal in a few hours.

(*g*) If after a wound of the chest there be spitting of blood, dysphagia, and liquids swallowed are found to escape at the external wound, a *wound of the œsophagus* (a rare accident) is to be diagnosed.

(*h*) Where, after a wound in the chest, there is a flow of clear serous fluid which becomes milky in appearance after a full meal, and the fluid on examination is found to consist of a very fine molecular base with globular nucleated corpuscles, and to contain much fat, a *wound of the thoracic duct* is to be recognised. This injury is very rare, and if the fistula continues open it leads to considerable emaciation and exhaustion.

(4) **Is there a foreign body in the wound?** —In some cases it is extremely easy to answer this question, but in many others it is quite impossible. A knowledge of the mode of infliction of the wound, whether by gunshot, stab, or prick, is important, and an examination of the clothes should always be made. In cases of stab wounds, the weapon used should be carefully examined for any evidence of recent fracture. In cases of bullet wounds, an inspection of the pistol may show how many bullets have been discharged, and they should then be sought for where the shots were fired, and in the patient's clothes. By these facts it may be shown to be extremely improbable that any foreign body is lodged in the wound, or, on the contrary, practically certain that such is the case.

The next step will be to examine the wound. A knife-blade may be found transfixing a rib, or the end of a needle projecting through or under the skin, or a finger or a probe may detect a bullet in the wound, or the detachment of the part of a rib. Where there is a history clearly pointing to the lodgment of a foreign body, the onset of acute inflammation of the wounded part running on to suppuration confirms the suspicion. In some instances, when the collection of pus (empyema or pulmonary abscess) has been evacuated the foreign body has been discharged with the pus, or detected on an examination of the cavity with the probe, and removed. In the case of a needle or knife-blade or similar body transfixing the præcordial region, if a movement is communicated to it by the contraction of the heart it shows that it is *impacted in the heart.* Where the history indicates the lodgment of a foreign body in the pulmonary region of the chest, and there are no indications of a wound of the lung, and acute pleurisy and empyema ensues, it points to the presence of the foreign body in the *sac of the pleura.* Where, on the other hand, the signs are those of wound of the lung, and especially if pneumonia and a pulmonary abscess suddenly bursting into a bronchus occur, it points to the lodgment of the body *in the lung.* A certain diagnosis is not always possible.

C. **The secondary complications of injuries of the chest.**—The sequelæ of injuries of the chest are, with one exception, inflammations of the various structures involved, which frequently terminate in suppuration. It may be useful to append a list of them :

(*a*) Muscular rheumatism,
(*b*) Subpectoral abscess,
(*c*) Peripleuritic abscess,
(*d*) Pleurisy,
(*e*) Empyema,
(*f*) Pneumonia,
(*g*) Gangrene of the lung,
(*h*) Mediastinal abscess,
(*i*) Pericarditis,
(*k*) Myocarditis,
(*l*) Endocarditis,
(*m*) Pneumocele.

If the patient convalesce without pyrexia, pain, dyspnœa, syncope, palpitation, or other sign of respiratory or circulatory difficulty, it indicates an absence of these complications. But the accession of pain, or especially of fever, with or without an initial rigor, of increased dyspnœa, or of signs of cardiac failure should at once excite suspicion, leading to a careful examination of the chest, while a knowledge of the nature of the original injury will suggest the inflammatory lesions to be especially anticipated. Thus simple fracture of the rib is not unfrequently followed by pleurisy, with or without effusion; wound of the pleura and hæmothorax often runs on to empyema, wound of the lung to pneumonia, and a bruise may lead to muscular rheumatism. First examine the chest walls for any evidence of "rheumatism" or of swelling, and then make a systematic physical examination of the lungs and heart.

(*a*) If after a contusion of the chest, or some sudden strain, the patient continue to suffer from a localised pain on taking a deep breath, or on coughing, or on attempting to contract any of the thoracic muscles, and if the painful part be also tender, with no evidence of a fracture of a rib (*see* page 142), or of pleurisy (*see* page 129), or other intrathoracic complication, *i.e.* if there be no friction and no dulness on percussion, *muscular rheumatism*, intercostal or other, must be diagnosed.

(*b*) When with the general signs of inflammation the front of the chest is found swollen, the swelling being ill-defined, boggy, and œdematous in nature, attended with considerable pain and tenderness and great pain on raising the arm forwards; and further when it is known that this swelling did not immediately follow the injury; a *subpectoral abscess* is to be diagnosed. In these cases the pus is often too deep to give rise to fluctuation; where there is doubt an exploring needle or trocar may be introduced: *fluctuation will be earliest* detected in the axilla.

mistaken for the lung, a mistake which may be avoided by noticing the lobulated condition of the omentum, and the smoothness and crepitation of the lung.

(*c*) Where there is extensive emphysema complicating a wound, or marked pneumothorax, hæmothorax, free hæmoptysis, or distinct traumatopnœa, and especially where two or more of these are met with together, a *wound of lung* is to be diagnosed.

(*d*) If a wound over the region of the heart be followed by tympanitic resonance over the cardiac area, with (sometimes without) a loud ringing character of the heart sounds, and if after a short interval there be dulness over more or less of the lower part of the cardiac area, with a tympanitic note above, a raised position of the heart's impulse, dyspnœa, distress, epigastric pain and quickened feeble pulse, followed in a few hours by pericardial friction, the evidence warrants the diagnosis of *wound of the pericardium*, leading to *pneumopericardium*, *hæmopericardium* and *pericarditis.*

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(*f*) A wound over the great thoracic blood vessels, followed by profuse hæmorrhage and all the signs of extensive *hæmomediastinum*, with collapse, syncope, and dyspnœa, is complicated with *wound of a great blood-vessel;* such injuries are with few exceptions certainly fatal in a few hours.

(*g*) If after a wound of the chest there be spitting of blood, dysphagia, and liquids swallowed are found to escape at the external wound, a *wound of the œsophagus* (a rare accident) is to be diagnosed.

(*h*) Where, after a wound in the chest, there is a flow of clear serous fluid which becomes milky in appearance after a full meal, and the fluid on examination is found to consist of a very fine molecular base with globular nucleated corpuscles, and to contain much fat, a *wound of the thoracic duct* is to be recognised. This injury is very rare, and if the fistula continues open it leads to considerable emaciation and exhaustion.

(4) **Is there a foreign body in the wound?**—In some cases it is extremely easy to answer this question, but in many others it is quite impossible. A knowledge of the mode of infliction of the wound, whether by gunshot, stab, or prick, is important, and an examination of the clothes should always be made. In cases of stab wounds, the weapon used should be carefully examined for any evidence of recent fracture. In cases of bullet wounds, an inspection of the pistol may show how many bullets have been discharged, and they should then be sought [for where the shots were fired, and in the patient's clothes. By these facts it may be shown to be extremely improbable that any foreign body is lodged in the wound, or, on the contrary, practically certain that such is the case.

The next step will be to examine the wound. A knife-blade may be found transfixing a rib, or the end of a needle projecting through or under the skin, or a finger or a probe may detect a bullet in the wound, or the detachment of the part of a rib. Where there is a history clearly pointing to the lodgment of a foreign body, the onset of acute inflammation of the wounded part running on to suppuration confirms the suspicion. In some instances, when the collection of pus (empyema or pulmonary abscess) has been evacuated the foreign body has been discharged with the pus, or detected on an examination of the cavity with the probe, and removed. In the case of a needle or knife-blade or similar body transfixing the præcordial region, if a movement is communicated to it by the contraction of the heart it shows that it is *impacted in the heart.* Where the history indicates the lodgment of a foreign body in the pulmonary region of the chest, and there are no indications of a wound of the lung, and acute pleurisy and empyema ensues, it points to the presence of the foreign body in the *sac of the pleura.* Where, on the other hand, the signs are those of wound of the lung, and especially if pneumonia and a pulmonary abscess suddenly bursting into a bronchus occur, it points to the lodgment of the body *in the lung.* A certain diagnosis is not always possible.

C. **The secondary complications of injuries of the chest.**—The sequelæ of injuries of the chest are, with one exception, inflammations of the various structures involved, which frequently terminate in suppuration. It may be useful to append a list of them :

(*a*) Muscular rheumatism,
(*b*) Subpectoral abscess,
(*c*) Peripleuritic abscess,
(*d*) Pleurisy,
(*e*) Empyema,
(*f*) Pneumonia,
(*g*) Gangrene of the lung,
(*h*) Mediastinal abscess,
(*i*) Pericarditis,
(*k*) Myocarditis,
(*l*) Endocarditis,
(*m*) Pneumocele.

If the patient convalesce without pyrexia, pain, dyspnœa, *syncope,* palpitation, or other sign of respiratory or circulatory difficulty, it indicates an absence of these complications. But the accession of pain, or especially of fever, with or without an initial rigor, of increased dyspnœa, or of signs of cardiac failure should at once excite suspicion, leading to a careful examination of the chest, while a knowledge of the nature of the original injury will suggest the inflammatory lesions to be especially anticipated. Thus simple fracture of the rib is not unfrequently followed by pleurisy, with or without effusion; wound of the pleura and hæmothorax often runs on to empyema, wound of the lung to pneumonia, and a bruise may lead to muscular rheumatism. First examine the chest walls for any evidence of "rheumatism" or of swelling, and then make a systematic physical examination of the lungs and heart.

(*a*) If after a contusion of the chest, or some sudden strain, the patient continue to suffer from a localised pain on taking a deep breath, or on coughing, or on attempting to contract any of the thoracic muscles, and if the painful part be also tender, with no evidence of a fracture of a rib (*see* page 142), or of pleurisy (*see* page 129), or other intrathoracic complication, *i.e.* if there be no friction and no dulness on percussion, *muscular rheumatism*, intercostal or other, must be diagnosed.

(*b*) When with the general signs of inflammation the front of the chest is found swollen, the swelling being ill-defined, boggy, and œdematous in nature, attended with considerable pain and tenderness and great pain on raising the arm forwards; and further when it is known that this swelling did not immediately follow the injury; a *subpectoral abscess* is to be diagnosed. In these cases the pus is often too deep to give rise to fluctuation; where there is doubt an *exploring* needle or trocar may be introduced: fluctuation will be earliest detected in the axilla.

(*c*) If, after a contusion or small punctured wound of the chest which has healed, the patient become ill, feverish with high temperature, perhaps a rigor or rigors, with pain in the side, the site of the injury should be carefully examined. If, now, that part of the chest be found enlarged, with one or more intercostal spaces widened and bulging, while the ribs above are even closer together than normal; and if fluctuation can be detected in these bulging spaces, and if they are noticed to become less prominent during inspiration and more tense and full during expiration; if this area be dull on percussion and vocal fremitus be abolished over it, and the respiratory murmur be weak, but there be no friction heard; and, further, if the heart be not displaced to the opposite side, or the liver or other abdominal organs depressed, *peripleuritic abscess* should be diagnosed; if on tapping the swelling pus flow out from the part more forcibly and rapidly during expiration, this diagnosis will be confirmed. Bartels asserts that the pus from such an abscess is of a higher specific gravity than that from empyema, the latter not being above 1032, while the former, in one case observed by him, was as high as 1041. In such a case the diagnosis lies between empyema and peripleuritic abscess, and the attention must be directed especially to the following points. In empyema, the distension of the chest is uniform, and "pointing" is a late sign; while in peripleuritic abscess the distension is more localised, and "pointing" is noticed earlier. In empyema, the dull area nearly always involves the lowest part of the pleural sac, even if it rises high up, and its upper level may be modified by position. In abscess there may be a resonant area below the dull area in which the respiratory movements and sounds are normal, and the level of dulness is quite unaffected by position. In empyema there is displacement of the neighbouring organs, in abscess there is not; in empyema a difference in tension of the swelling during inspiration and expiration is not observed, and on tapping the collection of pus, the flow is not at first affected by respiration, but only later on. Peripleuritic abscess is a very rare affection; it may arise spontaneously as well as from injury; it may burst into the pleura and set up purulent pleurisy, or spread to the mediastinum and pericardium, involving those tissues in suppuration.

(*d*) If, on auscultating the chest, a dry rubbing or creaking sound be heard with inspiration and expiration, limited to a certain area of the chest, and unattended with dulness on percussion, it indicates *dry pleurisy.* Such friction may be heard just above a pleuritic effusion or over a pneumonic lung.

(*e*) If one side of the chest be found enlarged, with bulging of the intercostal spaces, and great lessening of the respiratory movements, and is dull on percussion, with loss of vocal fremitus, while the breath-sounds are inaudible, or are distant, weak, and bronchial in character, and the vocal resonance is distant and bronchophonic; and if, further, there be displacement of the heart to the opposite side, and if on the right side, of the liver downwards with exaggerated breathing in the opposite lung, there can be no doubt that there is an accumulation in the pleural sac. These signs, found quickly after the injury, point to *hæmothorax;* coming on after an interval of a day or two, or increasing at that time, and especially when attended with fever and increasing dyspnœa, they clearly indicate *pleurisy with effusion,* while if the temperature continue to rise and remain very high, or if there are rigors with sweatings, and emaciation; or if a localised fluctuating swelling form in any part of the chest wall, *empyema* is to be diagnosed. Wherever any doubt as to the nature of the fluid in the chest is entertained, a small exploring syringe should be introduced and a portion of the fluid withdrawn for examination. This method of diagnosis, the most certain of all, is justly coming more and more into use.

(*f*) If the examination of the chest show localised dulness around the wound, with tubular breathing, fine crepitation, and bronchophony, and the patient be febrile, with sharp pain in the chest, cough, and rusty expectoration, *traumatic pneumonia* is to be diagnosed. This form is less severe and less extensive than the idiopathic. If combined with pleurisy, the physical signs will be modified, and reliance in the diagnosis of *pleuro-pneumonia* will be placed especially on the combination of rusty expectoration, tubular breathing, and fine crepitation with loss of vocal fremitus, bulging of intercostal spaces and perhaps friction. Should the inflammation attack a portion of lung that has been wounded, coarse, moist râles may be heard. If, in a case of pneumonia, the patient suddenly cough up a quantity of pus, it will point to an *abscess* in the lung, which has burst into a bronchus; and if now the signs of a cavity are present where before there was evidence of pulmonary consolidation, this diagnosis and the exact position of the abscess will be established.

(*g*) If, with or without evidence of traumatic pneumonia, the patient, some days after the injury, cough up dark and extremely fœtid sputa, and the breath have a horribly fœtid odour, the diagnosis of *gangrene of the lung* is to be made. This may be confirmed by detecting shreds of pulmonary tissue in the expectoration, the elastic fibres having a characteristic clear defined outline under the microscope, and resisting the action of acetic acid. An at-attempt should be made to localise the gangrene for the purpose of treatment; and if an area of dulness, with moist râles and hollow respiratory murmur be detected, that may be regarded as the seat of the disease. Gangrene is a rare sequel to chest injuries, but is met with occasionally after contusions and wounds, particularly if the lung is much lacerated or a foreign body is retained.

(*h*) If in a case of *pneumo-* or *hæmo-mediastinum*, or of severe blow or wound of the sternum, the distress of the patient become considerably increased, and there be palpitation of the heart, and dyspnœa, or œdema and signs of venous obstruction in the head, neck, and upper limbs, and on percussion a dull area is found over the sternum and extending laterally over the costal cartilages, and if with this there be pyrexia, with, perhaps, rigors, the surgeon must suspect *mediastinal abscess.* Careful examination of the suprasternal notch of the intercostal spaces close to the sternum and of the epigastrium should then be frequently made, and if at either of these situations a soft fluctuating swelling appear, which may have a pulsation transmitted from the heart, or become fuller and more tense during expiration, this diagnosis will be established. The diagnosis will probably not be made before the abscess "points;" but when it is suspected, an exploring syringe should be carefully introduced. The abscess may suddenly burst into either the pleura or the pericardium, setting up acute inflammation. Death often takes place before pointing has occurred.

(*i*) Even within a few hours after a wound of the pericardium, friction may be heard over the cardiac area, showing the development of *pericarditis.* Pericardial friction is to be distinguished from pleuritic friction by the place where it is heard, by its being unmodified by respiration, and accompanying both sounds of the heart; and from endocardial murmurs, by its creaking or rubbing character, its uniformity with both sounds of the heart, its strict limitation, its want of conduction along the vessels or round into the axilla, and in some cases by its modification by firm pressure with the stethoscope. If this be followed by an increase in the area of cardiac dulness which takes the shape of the pericardium, with displacement upwards and to the left of the heart's impulse (which may be quite lost) increased frequency of the heart's action and loss of the heart sounds over much of the dull area, while the pulse is small and weak, and dyspnœa very marked, the patient sitting up in bed and leaning forward, and having a frequent dry short cough, *pericardial effusion* has occurred. Should rigors occur, and there be any tendency to "point" in any part of the dull area, *pyopericardium* may be diagnosed ; an exploring syringe will at once determine the nature of the fluid in the sac.

(*k*) When, in connection with pericarditis, the heart's action becomes extremely weak and irregular, leading to syncope on movement or sitting upright, the existence of *myocarditis* is to be inferred. There are no positive signs by which its presence may be demonstrated.

(*l*) If the surgeon be able to recognise the development of an endocardial murmur after a contusion, strain or other injury of the chest, *i.e.* if he at his early examination find the heart sounds clear, and subsequently note a murmur, it is evidence of the occurrence of *endocarditis*. The time, place of greatest intensity, and the direction of conduction of the murmur will enable a precise diagnosis of the valvular affection to be made. For this, reference should be made to works on medicine.

(*m*) If, after a wound in the chest has healed, or after a severe contusion, a tumour slowly and gradually appear, which is circumscribed, smooth, soft, rounded, crepitant under pressure, resonant on light percussion, with an impulse on coughing, expanding with each expiration and contracting during inspiration, it is a consecutive prolapse of the lung, or a *pneumocele.* These tumours may appear rapidly and attain a large size; they may be more or less reducible, allowing the outline of the aperture through which the lung escapes to be felt.

CHAPTER XI.

THE DIAGNOSIS OF INJURIES OF THE ABDOMEN.

Injuries of the abdomen, as of the head and chest, derive their chief interest from the importance, and usually great danger, of any lesion of the viscera contained within the cavity. Hence, the question which above all presses for an answer is, whether any given injury has merely bruised or wounded the parietes, or whether there is a visceral lesion as well; and if the latter, which of the several viscera has been damaged. While visceral lesions are generally the result of the more severe forms of violence, the surgeon must always remember that even by apparently trivial blows fatal visceral ruptures may be caused, while recovery may take place after more severe contusions. In arriving at a diagnosis of a case of abdominal injury, it is well to consider that the patient is the subject of a visceral lesion until the contrary can be proved, and to employ the method of exclusion; and further, when examining the patient, the utmost gentleness of manipulation must be employed, lest the surgeon's fingers or the patient's movements should convert an incomplete into a complete rupture, or induce a renewal of hæmorrhage that Nature has arrested.

Abdominal injuries are to be divided into *con-*

tusions and wounds, of which the former are much the more common in civil practice, and form an exceedingly serious and highly fatal class of cases. The *sequelæ* of each group will be considered separately.

Exact diagnosis may be impossible when the patient is first seen. The absence of all acute symptoms, or of symptoms distinctly pointing to a visceral lesion, is not enough to justify the surgeon in proclaiming the injury unimportant; but he should wait to see whether any severe symptoms, especially inflammatory symptoms, set in. For example, there may be nothing to indicate soon after the injury even such a severe lesion as a rupture of the intestines, but in a few hours the onset of acute peritonitis will reveal the gravity of the case. The same holds good in the case of wounds. It is only if the patient *continue* to be free from severe symptoms that a diagnosis of a simple superficial lesion can be made.

A. **Contusions.**—There may be no indications whatever on the exterior of the severity of internal lesions; but no case, however trivial it may appear, is to be dismissed without a careful consideration of all the circumstances, and without waiting to see whether serious symptoms do or do not quickly ensue. Some assistance in diagnosis is to be obtained by a precise knowledge of the injury inflicted, whether a fall or blow or crush, and of the exact spot struck, and of the condition of the abdominal viscera at the time, especially whether the stomach or bladder was full. Attention is to be particularly directed to the general condition of the patient, to any evidence of shock or collapse, or of internal hæmorrhage, and to local signs, pain, tenderness, vomiting, emphysema and hæmaturia. *Pain* is, of course, a symptom of all injuries; but when it is intense, and increases spontaneously, *i.e.* without any movement on the part of the patient, or is fixed in one spot, and from that gradually radiates over the belly, it becomes of very serious portent. Similarly, *shock* may be produced simply by contusion of the solar plexus and its branches; it is most intense immediately after the injury. When shock continues long, and especially when it gradually deepens, or when *collapse* only comes on at an interval after the injury, or when the patient has to some extent, if not entirely, recovered from the primary shock, the indication of a severe internal injury is very marked. *Vomiting* is another very frequent symptom. When a person receives a blow on the belly soon after a meal, vomiting simply to the extent of emptying the stomach is common, and has no serious significance; but when the act is often repeated, and becomes "persistent," and particularly when the ejecta contain blood or bile, it is an important sign of visceral lesion. The significance of *hæmaturia*, or of the passage of *blood by the bowel*, is too obvious to require comment; but it may be pointed out, that if bright-red blood be passed per anum as the result of an abdominal injury, it points to a lesion of the colon, while an altered condition of the blood (tarry stools) would show that it comes from some part of the alimentary canal farther removed from the anus. *Subcutaneous emphysema* is not often observed in connection with abdominal injury; when it is, care must be taken to determine whether it is thoracic or abdominal in origin. Of the former we have previously spoken (*see* page 127); the seat of the injury and the place where the swelling first appears are the signs by which this distinction is to be drawn. When abdominal in origin, it usually makes its appearance first in one or other loin or groin, and it indicates a rupture of the intestine; and when, as is usually the case, it is not combined with pneumo-peritoneum, or gas in the general peritoneal cavity, it points unmistakably to a rupture of some part of the gut where it is uncovered by peritoneum, such as the back of the second and third parts of the duodenum, of the cæcum, or of the colon. The same symptom is occasionally observed in injuries of the rectum.

In the absence of severe shock, or of increasing collapse, of severe pain, of vomiting, of emphysema, or of hæmaturia, the probability is that there is *no visceral lesion;* but such a conclusion is then conjectural, and it becomes absolute only when time has failed to elicit other signs, especially peritonitis and the formation of a tumour.

When with pain which is neither very intense, nor increases spontaneously, but is exaggerated when the patient contracts the abdominal muscles in respiratory or general movements, there is swelling of the abdominal walls and the well-known discoloration of a bruise, it must be recognised as a *bruise of the abdominal wall;* and when to this is superadded the presence of a gap or depression in the course of a muscle (and this especially happens in the case of the rectus abdominis muscle), it indicates a *rupture of a muscle.* It may happen that the gap in the muscle is not recognised until after the absorption of the effused blood.

If a patient have received an injury upon the right hypochondrium, and complain of fixed and severe pain in that region, and if the shock be marked or, especially, collapse increase after the injury, with signs of internal hæmorrhage (blanching, sweating, syncope, quick feeble pulse), *rupture of the liver* must be suspected. If now there be persistent vomiting, and the vomited matters contain bile, but not blood; if there be an increase of the normal liver dulness, and especially if there be subsequent ascites, jaundice, and the passage of pale clayey stools, the suspicion is converted into a certainty. In a large majority of the cases of this injury, as of others to the abdominal viscera, death quickly ensues. Cases of recovery are by no means unknown, and the author quite recently had the opportunity of watching two in which the above-mentioned symptoms left no doubt as to the nature of the injury sustained. Sugar may be found in the urine after injuries to the liver.

If an injury to the epigastrium or left hypochondrium of a patient who has recently taken a meal be immediately followed by intense pain in the injured part, which quickly radiates over the whole belly, by extreme shock from which the patient does not rally, and by repeated painful vomiting with hæmatemesis, the diagnosis of *rupture of the stomach* may be arrived at. This injury, fortunately, is rare; it only occurs when the viscus is more or less distended, and it appears to be invariably fatal. The suffering it occasions during the short time the patient survives is intense, and is shown by the extreme anxiety depicted on the countenance.

When, following a blow upon the belly, especially about the umbilical and hypogastric regions, the patient is immediately seized with severe pain in the part struck, which then radiates over the belly, and on laying the hand on the belly wall the muscles are found rigidly contracted and immovable, and the patient complains of tenderness, and there is vomiting, constipation, and collapse, *rupture of the intestine* is to be diagnosed. The collapse is usually severe; but it may be slight, and the general symptoms only become severe when the peritonitis excited by the fæcal extravasation sets in. Should there be subcutaneous emphysema, or the passage of blood per anum (the history of the case and examination alike excluding any injury to the rectum) the diagnosis of intestinal rupture becomes still more positive. The signs of this injury may be quite absent when the patient is first seen.

The author well remembers the case of a lad who was struck in the belly with a piece of wood, who, when seen shortly afterwards, was not suffering from collapse, severe pain, vomiting, or any symptom pointing to a grave visceral lesion; but peritonitis quickly set in and proved fatal, and at the autopsy a complete rupture of the ileum was found.

If a blow upon the left hypochondrium be followed by deepening collapse, blanching of the surface, syncope, and the other general signs of internal hæmorrhage, and if pressure under the left margin of the chest elicit tenderness, and especially if the splenic dulness to percussion be increased downwards and forwards, a *rupture of the spleen* is to be diagnosed. When the rupture is extensive the hæmorrhage is profuse, and if not fatal, is followed by peritonitis; the position of the blow and of the dulness caused by the accumulating blood are then the only signs to be relied upon for diagnosis. Should the position of the blow be unknown, or the injury more diffuse, and the local dulness masked, or not made out, it would be impossible to distinguish this injury from any other source of internal hæmorrhage.

When an injury to the loin is followed by hæmaturia, the blood being intimately mixed with the urine, sometimes forming long slender "casts" of the ureter, a *rupture of the kidney* of the same side is to be diagnosed. Should the loin be found bruised, painful and tender, and if there be pain in or retraction of the testicle, or pain or numbness down the front of the thigh, the diagnosis will be confirmed. Where the patient has received a very severe crushing injury of the loin, and there is much bruising of the part, deep swelling, pain, and tenderness on trying to feel the kidney, especially when, combined with these signs, there is marked collapse, even in the absence of hæmaturia. a rupture of the kidney may be suspected to have been produced, the ureter being obstructed.

For the diagnosis of *rupture of the bladder, see* page 166.

If, after a blow on the belly, which may or may not be attended with more or less shock, the patient become increasingly collapsed, with a rapid, feeble, fluttering pulse, shallow and sighing respiration, blanching of the skin and of the mucous surfaces, and restlessness, *internal hæmorrhage* is going on. In some cases there is marked abdominal distension, due to the effused blood. In the absence of symptoms indicating the rupture of one of the large solid viscera, it is impossible to determine the source of the bleeding ; it may be the mesenteric vessels, or the vena cava, or any other of the large vessels of the belly. The restlessness of the patient may be a very marked symptom, and is in strong contrast to the dread of movement, especially of abdominal movement, in cases of rupture of the intestine. If vomiting occur at all, it is not the persistent emesis so distressing in rupture of the stomach, of the liver, or of the intestine.

When, after a sudden strain or severe injury, the patient complains of a sharp pain in the left side of the chest, and of dyspnœa, and is found unable to take a full inspiration and to "fix" the diaphragm, a careful examination of the left chest should be made. If now the heart's apex be found displaced to the right, and the normal area of pulmonary resonance encroached upon from below either by the tympanitic note of the stomach or colon, or by dulness, and the respiratory sounds are absent over the same area, but of normal character above, and if, further, the patient complains of severe thirst, and is repeatedly sick, *rupture of the diaphragm with hernia* may be recognised. This accident always occurs on the left side, and it may be but a part of a very severe and quickly fatal lesion, and escape recognition. When resulting from a sudden spasm of the muscle, the sharp pain followed by the inability to fix the diaphragm, the thirst and the special physical signs clearly point to the nature of the lesion. Diaphragmatic hernia may be a congenital affection, and, therefore, it is only when the symptoms associated with it come on acutely after a strain or injury that the traumatic lesion must be diagnosed.

If a pregnant woman receive a blow upon the belly, and complain of pain shooting down to the vulva, perineum, and thighs, and if the outline of the uterus be preserved unaltered, and there be neither hæmorrhage from its cavity, nor severe shock, it is a *contusion of the uterus;* abortion will probably result.

If, under similar circumstances, the woman be found collapsed, with signs of loss of blood, and blood be found flowing from the uterus into the vagina, *rupture of the uterus* has taken place; and if the outline of the uterus be lost, and, in place of it, the head and limbs of the fœtus can be plainly traced through the belly wall, the fœtus has escaped through the rent into the peritoneal cavity.

If a woman known to have an ovarian tumour fall on the belly, or receive a blow there, and then become faint, and complain of pain, and the outline of the tumour be altered or quite lost, and there be dulness in each flank, which disappears on turning the patient on to the opposite side, and a fluctuation wave can be felt across the belly, *rupture of an ovarian cyst* is to be diagnosed. Even without the knowledge of the prior existence of an ovarian tumour, the detection of free fluid in the peritoneal cavity immediately after an injury to the belly of a woman, the presence of shock, and the history of a "snap," or "bursting," being experienced at the time, especially in the absence of jaundice, or disease of the heart or lungs, would render the diagnosis of rupture of an ovarian cyst very probable.

B. Sequelæ of contusions of the belly.

- Peritonitis.
- Abscess.
- Urinary cyst.

The most frequent and the most fatal sequela of an abdominal contusion is peritonitis. It may follow upon the infliction of a very moderate amount of violence, and hence no contusion of the belly is to be regarded as of trivial importance. Severe internal lesions, unless fatal from shock or hæmorrhage, quickly induce peritoneal inflammation. Peritonitis very generally arises within a few hours of the accident; it may come on later. Abscess is a less frequent, but by no means rare, sequel of an abdominal injury. It may form in the belly wall from a bruise in that part, or in the subperitoneal tissue, probably from a bruise or minute rupture of the bowel where uncovered by peritoneum, with a limited escape of fæces, or from a rupture of the peritoneal surface of the bowel if, happily, the effused lymph glue the adjacent coils of intestine together, and prevent general extravasation of fæces; it is also met with between the liver and the diaphragm, probably as the result of a bruise or small laceration of the upper surface of the liver. The early diagnosis of these abscesses is important; for, while their treatment is successful, if neglected they may burst into the general peritoneal cavity and cause fatal peritonitis; the subdiaphragmatic abscess may burst into the pleura or the lung.

When, a few hours or more after an accident, the patient complains of diffused pain over the abdomen, and is found lying upon his back with his knees drawn up, with pinched features clearly expressing distress, and on examining the belly it is seen to be immovable during respiration, which is wholly upper costal, and the least pressure with the hand upon the abdominal wall is resented on account of the pain it produces, and especially if there is increasing flatulent distension, vomiting, and constipation, *acute peritonitis* is to be diagnosed. The signs of this affection vary within wide limits. Severe pain in the back is sometimes complained of, rather than pain in the belly; there may be little or no tenderness; the distension may be enormous, or, on the other hand, but slightly marked, the belly being retracted, and the muscular contraction making the wall firm and resistent. The pulse is quickened by the onset of the inflammation, and may be small and incompressible, or "wiry." The temperature may be considerably elevated, or but little above the normal. In the absence of all evidence of visceral lesion, the occurrence of peritonitis may be taken as pointing to laceration of the peritoneum, or of the mesentery; but no certain diagnosis of these lesions can be made.

When a contusion of the abdomen is followed by the formation of a localised swelling and general febrile disturbance, an *abscess* must be suspected. Such swelling may follow an obvious bruise of the belly wall, in which case the onset and progress of inflammation are marked by increasing swelling, bright redness, greater pain, acute tenderness and fever. Or there may have been no external evidence of bruising, and febrile illness, local pain, and then the gradual occurrence of a more or less well-defined swelling may be the only symptoms. Examine carefully for fluctuation and for surrounding œdema, and these signs, when obtained, or the occurrence of shivers, or of remittent temperature, will render the diagnosis of abscess more certain. Wherever doubt as to the nature of such a swelling is entertained, an exploring needle or syringe should at once be passed, as it is important that these abscesses should be evacuated as early as possible. The surgeon will endeavour to make out the seat of the abscess. When the redness and swelling appear early and fluctuation is quickly and readily perceived, and particularly if the swelling be found to be movable with the belly walls, it is to be diagnosed as a superficial abscess. In other cases the swelling and the area of fluctuation may be limited to one of the compartments of the sheath of the rectus muscle. But where the pus is deep it is always difficult, and it may be impossible, to tell its exact position. In the lumbar region the abscesses occur in the fat on either side of the fascia transversalis ; in the iliac fossa suppuration is apt to arise in the pericæcal fat ; pus may form in the subperitoneal fat of the belly wall, and in the peritoneal cavity, being limited by adhesions of the omentum and coils of intestines to one another and to the belly-wall. When the abscess is opened exploration with the finger may be able to determine its exact situation. The character of the pus that is contained in the abscess must be noticed ; when comparatively superficial, it will be laudable pus, or a mixture of pus and blood ; where the abscess is around intestine, especially cæcum and colon, it will be discoloured brown, and of a very fœtid or feculent odour ; and should fæcal matter or flatus be mixed with it, or follow the escape of pus, it proves that the intestine is perforated, and a *fæcal fistula* will result.

Suppuration may occur between the liver and the diaphragm, and from its deep position its detection may be very difficult. These abscesses are sometimes the result of the perforation of a gastric or duodenal ulcer, but they may arise from injury. As the pus accumulates it pushes up the diaphragm and depresses the liver, and it may point, and burst externally, or into the peritoneal cavity ; not uncommonly it perforates the diaphragm and the base of the lung, and the pus is expectorated through the bronchi. When, therefore, after an injury to the right hypochondrium the patient continues febrile, particularly if there are one or more rigors, the injured region should be carefully explored, and if the lower edge of the liver be found depressed below the normal, while its area of dulness reaches up to or is above the normal level, and if there be local pain, or any fulness of the intercostal spaces, *subphrenic abscess* is to be suspected. Should the abscess have pointed externally and give fluctuation the diagnosis becomes easier. But in all such cases an exploring syringe should be introduced to determine the presence of pus. But the question will even then arise whether the pus is above or below the diaphragm. To decide this, observe whether the onset of the disease was characterised by the signs of pleurisy or not; whether there was sharp pricking or stabbing pain on taking a deep breath, cough and dyspnœa; and whether at any time pleural friction was to be detected. The absence of these signs would indicate that the inflammation was below the diaphragm, but their presence would not prove the contrary. Further, examine the chest, to learn whether on taking a full inspiration the level of pulmonary resonance descends, and if the respiratory sounds are normal; the former of these two signs is a significant indication that the purulent collection is not in the pleural cavity.

When a swelling forms slowly and gradually in one of the lumbar regions after an injury in that situation, unattended with fever, acute pain, or tenderness, and this swelling be found to fluctuate, a *rupture of the ureter*, with the formation of an *urinary cyst*, is to be diagnosed; and if, on tapping, the swelling watery fluid containing urea* be drawn off, this diagnosis is confirmed. Observation of a diminution of the quantity of urine or of urea excreted daily since the injury would render the diagnosis more easy and certain.

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* *See* footnote, page 161.

C. **Wounds.**—In examining a wound of the belly the surgeon must endeavour to determine whether it is limited to the parietes, or whether it penetrates the peritoneal cavity; if the former, whether it is superficial, or extends through one or more of the muscular and deep aponeurotic layers; if the latter, whether there is protrusion or wound of any of the viscera; and, in all cases, whether any foreign body is lodged in the wound. Punctured wounds are those which generally present both the greatest difficulties in diagnosis, and the greatest dangers, for their small external size renders their exploration often unsatisfactory, and they are frequently penetrating and complicated with wounds of viscera; bullet-wounds partake of the same characters. Enquiry should always be made as to the manner in which the wound was inflicted, and the instrument used should be examined, to discover, when possible, how deeply it has penetrated, and whether it is entire, or whether any part of it has been recently broken off.

(1) **Is the wound penetrating?**—In some cases a wound is obviously non-penetrating, and in others, especially when punctured, it may be impossible to decide. The edges of an incision may be gently drawn aside, and its surfaces explored; when it extends only through the skin and superficial fatty tissue it is to be called a *superficial parietal wound;* when, however, it severs a muscle, or the muscular aponeurosis, and opens up the intermuscular planes or the sheath of the rectus muscle, or even still deeper fasciæ, the danger of diffuse inflammation and suppuration renders it necessary to distinguish it from the former as a *deep parietal wound.* Should there be *any* visceral protrusion, or the escape of the contents

of any of the viscera (food, bile, fæces, urine) or a flow of clear serous fluid, or of dark blood from the depth of the wound, which flows faster and with more force when the patient coughs or makes any effort, or should there be severe shock or the signs of internal hæmorrhage, hæmaturia, or hæmatemesis, or the passage of blood per anum, it may be diagnosed as a *penetrating wound.* When a doubt is entertained, probing or any like exploration of the wound must not be made, but the treatment must be adapted for the severer injury.

(2) **Is there protrusion of viscera?**—This fact can be ascertained quite easily in the majority of cases; the omentum and small intestine are the viscera most commonly protruded; but the liver, stomach, spleen, and bladder may be. Where the protrusion is large there can be no difficulty whatever in recognising it, although the possibility of a loop of intestine lying behind a fold of omentum must not be forgotten, and pains must be taken not to overlook a small protrusion of omentum between the lips of a wound. All deep wounds must be carefully examined with this view, and if anything like a protrusion, anything lying between the lips of the wound, is observed, it must be noted whether it has the characteristic granular appearance of omentum, or whether it differs in colour from the fat on the surface of the wound, whether it is congested, whether any large vessels appear on it, then it should be seized and gently drawn upon, and if a distinct pedicle on its deep surface be found, or, especially, if further prolapse takes place, the diagnosis is certain. With ordinary care, the smooth glistening surface of the intestine, stomach, and liver would be at once detected in a wound. It must be remembered that the urinary bladder when full may be protruded from a wound in the hypogastrium, even when the peritoneal cavity is not opened; when this lesion is

suspected, a catheter should be passed and all the urine drawn off, when the protrusion will be emptied, and will collapse; should a silver catheter be used, its extremity may be made to enter, and be felt in, the protrusion. Any visceral protrusion must be carefully examined for a wound in the protruded part, or the presence of dirt and foreign matters, and to note congestion.

(3) **Is there a wound of a viscus?**

(*a*) **Where there is protrusion of viscera.**—All protruded viscera should be carefully examined to see whether there is any rupture or wound, as well as to remove any foreign bodies that may be adherent to or entangled in them. In the case of omentum and mesentery note especially whether there is any hæmorrhage from a wounded artery or vein. The collapse of prolapsed intestine and stomach, and the escape of their contents, gaseous or semi-solid, may indicate at once a wound; but the whole surface should be explored to see whether the peritoneum is torn at any part, or whether there is at any spot a little projection of soft, red mucous membrane, indicating a puncture of the gut; a larger wound of the intestine can hardly escape observation.

(*b*) **Where there is no protrusion** the surgeon may be left in doubt on this point. But if undigested or partially digested food, unstained by bile, escape from the wound, or if the patient vomit blood, a *wound of the stomach* is to be diagnosed; this lesion will be attended by severe shock, and be followed by acute peritonitis. When fæcal matter escapes from the wound, or when blood is passed per anum, a *wound of the intestine* is also clearly evidenced. Where a wound is followed by the escape of urine, or by the occurrence of hæmaturia, a wound of the urinary apparatus has been made, and the position of the wound, and the patient's power over his bladder, will determine whether it is a *wound of the kidney or urinary bladder.*[*] Similarly, where bile escapes from a wound in the region of the liver, a *wound of the gall bladder or bile duct* may be diagnosed. When a wound is followed by syncope and deepening collapse, and blanching of the mucous surfaces, and especially if dark blood escape from the wound, or if the belly be distended at any part, or there be dulness in the flanks, which may be noticed to increase, *internal hæmorrhage* is occurring. The position and direction of the wound will enable the surgeon to surmise the source of the bleeding; it may be the liver, the spleen, the vena cava, vena portæ, or some other large abdominal vessel. Lastly, where, without such positive evidence, a penetrating or a punctured wound of the belly is quickly followed by acute peritonitis, a visceral wound is to be suspected as the cause of the intense inflammation.

D. Sequelæ of wounds of the belly.

Diffuse suppuration in belly walls.
Peritonitis.
Fistula.
Artificial anus.
Hernia.

When a wound of the belly wall is followed by considerable diffuse swelling of the tissues, with redness and œdema of the skin, pain, and tenderness, and the body temperature is raised, with all the general symptoms of pyrexia, *diffuse inflammation* of the abdominal wall is proceeding, which, if not quickly subsiding, runs on to *suppuration.*

Should the patient be attacked with pain spreading over the whole belly, and the part be found extremely tender, even the light pressure of the hand being resented, and the respiration be entirely thoracic, while abdominal distension increases, and may become extreme with vomiting and constipation, and the temperature is raised, *acute peritonitis* is to be diagnosed.

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[*] To determine whether a fluid is, or contains, urine, acidulate a portion of it with acetic acid, boil and filter it; then take some of the filtrate, add a few drops of nitric acid, and evaporate it, when shining rhombic plates of nitrate of urea will separate, and may be recognised under the microscope.

Should the patient recover so far as the general results of the wound are concerned, but the wound through the belly wall remain open as a fistulous track, and through this the contents of any one of the abdominal viscera continue to escape, there is a *fistula.* If the discharge be unstained with bile, acid in reaction, and contain food unaltered, or but partly digested, it is a *gastric fistula,* or possibly a fistula in the upper part of the duodenum, above the entrance of the bile duct. Should the discharge consist of the contents of the intestine, it is a *fæcal or intestinal fistula.* When the matter escaping is soft, pultaceous, odourless, or nearly so, and of a light colour, the communication is with the small intestine; and when the discharge is distinctly fæculent, dark in colour, with a strong fæcal odour, and mixed with much gas, the communication is with the large intestine. Should the discharge be bile unmixed with chyme, or a watery fluid containing urea, it would be respectively a *biliary or urinary fistula.* If, as the result of an operation, or of the natural separation of a slough of prolapsed intestine, the mucous membrane of the gut is immediately continuous with the skin, the intestine opening directly on the surface, it is an *artificial anus.* Should there be from such an aperture a soft, bright-red, corrugated projection, moistened with mucus, it is a *prolapse* of the mucous membrane of the artificial anus. But should there be from the aperture a smooth, rounded projection, covered by the same red mucous membrane, but emptying on gentle compression, leaving the mucous covering collapsed, it is a *hernia* of the artificial anus.

If a cicatrix in the belly wall be found to yield before the pressure of the abdominal contents, and a projection be formed at the spot, smooth, rounded, soft, with an expansile impulse on coughing, and tympanitic on percussion, it is a *hernia*. It may be reducible or irreducible; the coils of intestine are often visible through the thinned cicatrix, or these and masses of omentum may be plainly felt through. There is no distinct neck to the sac of such a hernia.

CHAPTER XII.

THE DIAGNOSIS OF INJURIES OF THE PELVIS.

CONTUSIONS of the pelvis are generally the result of heavy blows or kicks, falls from a height, or severe crushing violence. They naturally group themselves into three categories: injuries of the soft parts covering the bones, injuries of the bones, and injuries of the contained viscera. The examination should be conducted with a view to determine under which of these categories the injury falls; the visceral injuries are, of course, very much the most fatal, and occasion the most severe symptoms.

Bruising of the soft parts will be at once recognised by the characteristic discoloration, the dull aching pain, and the swelling, which varies in amount within very wide limits. If the blood be effused from vessels at some depth, the staining of the skin may not appear for a day or two. Sometimes the ecchymotic discoloration extends over a very wide area, and then it is important to learn where it was first noted, as that fact will throw some light upon the seat of the lesion. Whenever the bruising implicates the perineum, scrotum, or penis, careful inquiry should be made whether there has been, or is, any hæmorrhage from the urethra. If a more or less clearly-defined fluctuating swelling appear in the soft parts quickly after an injury, it is a *hæmatoma;* there may be no bruising of the skin around it; the blood may long remain fluid, or be quickly absorbed. Such swellings are most frequently found on the buttock.

Fracture.—The surgeon, having examined the soft coverings of the pelvis, should then place one hand on each side of the symphysis pubis (the patient lying flat on his back) and run them along the bones from before back, and then down along the pubic arch, and observe if there be any irregularity in the outline of the bones. He next should seize the iliac crest, or the anterior iliac spine, and try to move it on the rest of the bone; then he should press the bone on each side of the symphisis pubis backwards (at first gently, and gradually more and more forcibly), and then placing a hand on each side of the pelvis, should press inwards. Lastly, he may try whether pressure on the pubic spine is painful, and also whether the great trochanter of the femur of the one side is flattened or raised above the other (*see* page 203); and whether movement of the hip joint is painful.

If, by this examination, any marked irregularity in the outline of the pelvis, or mobility of any part of it, or crepitus, be detected, *fracture of the pelvis* is at once to be diagnosed; by noticing the position of the irregularity and of the crepitus, and the part that is movable, the seat of the fracture may be made out. No distinction need be drawn between these fractures and separations of the pelvic synchondroses. Inability to stand, pain on all movements of the hip joint, with great pain on pressing on the pubic spine, are said to indicate a *fissure across the acetabulum.* But if, with great pain on moving the hip joint, there be distinct crepitus, there is *fracture of the acetabulum* with detachment of the fragments; while if, with these signs, the trochanter be found approximated to the middle line, it points to displacement of the head of the femur into the pelvis. (*See also* page 216.) For the diagnosis of fracture of the sacrum and coccyx, *see* page 108.

Injuries of the pelvic viscera.—The condition of the viscera must be next ascertained. Be careful to learn their condition before the injury, especially whether the bladder was full and when it was last emptied; if a female, whether she was menstruating at the time, or pregnant, or whether she had been the subject of an abdominal tumour. Then ask what the patient's sensations at the time of the accident were, and note particularly any feeling of something "bursting," or "giving way;" inquire as to pain, its position, character, and time of onset, and whether there is desire to pass water or any tenesmus; particularly learn whether the patient has made any attempt to pass water, and if so, with what result, and whether any blood was passed, and notice whether any blood has flowed from the urethra independently of the act of micturition, from the rectum, or from the vagina. And then observe the patient's general condition, whether it indicates shock or not. The surgeon must not be misled by the entire absence of bruising of the skin to think that the viscera have escaped unhurt; extensive rupture of the bladder or of the uterus may occur without any external sign of so severe an injury.

As the urinary organs are those that suffer most frequently, the surgeon should consider them first.

If blood be found escaping, or be known to have escaped, from the urethra, and if there be bruising of the anterior part of perineum, perhaps entering into the scrotum, there is a *rupture of the urethra.* If the patient have tried to micturate, he may have been unable to do so, or the attempt may have been attended with a sudden increase of the swelling in the perineum and scrotum (extravasation of urine), or the act of micturition may have caused pain as the urine flowed over the rent in the mucous membrane. A catheter should now be carefully passed, and if it reach the bladder clear urine will flow off; if this can be done, it shows that the urethra is not torn completely across; but if the surgeon fail to pass the instrument, and especially if its end be found close under the skin, it is evidence that the urethra is torn quite through, and that it is not simply a superficial laceration. This injury is usually the result of a fall across a beam, or some similar accident.

If, as a result of a sudden strain, a patient experience severe pain in one or other groin, and at the same time, or quickly after, bright blood flow from the urethra, but micturition be performed normally, and if the testicle on the same side become painful, tender, and somewhat swelled, and subsequently waste, the accident is *rupture of the vas deferens.* The escape of the blood from the urethra will at first suggest an injury of the urethra; but the nature of the accident (a strain, not a blow), the absence of bruising in the perineum and scrotum, as well as the normal performance of micturition, will exclude that lesion, while these signs, and the irritation and subsequent wasting of the testicle, will establish the diagnosis.

If there be no evidence of rupture of the urethra, and the patient evince a great desire to pass water, and quite fail to do so, or pass but a few drops, a *rupture of the bladder* must be suspected. If, now, it be made out that the bladder was full at the time of the accident, and the patient felt something "burst," or "give way inside," and this was followed by acute pain in the hypogastrium and by shock, and that soon after a great desire to pass water was felt, with inability to expel anything more than a few drops; and if on examining the belly the bladder cannot be felt, although there may be dulness reaching up a variable distance above the pubes, and on passing the finger into the rectum no tense rounded fundus is to be made out, a catheter should be introduced, and if it be found to pass the usual distance without difficulty (the finger in the rectum will at once dispel any doubt as to its extremity having reached the bladder), but only a few drops of blood or urine escape along it; and further, if, by manipulation, it can be made to pass in its full length, and its end be very freely movable, or plainly felt under the belly wall, or a large quantity of urinous fluid then flow out, the diagnosis of *rupture of the bladder* is certain. In some cases the history is quite defective; in others, again, the patient retains the power to pass just a small quantity of urine, and the catheter passed into the bladder draws off an ounce or two of bloody urine; the diagnosis is then obscure. Reliance must be placed on the presence of shock, on the frequent desire to empty the bladder, the admixture of blood with the urine, the failure to detect, by any means of examination, a full bladder, and, especially, upon the results of catheterism, particularly the passage of the end of the instrument through the rent into the belly cavity, where it can be moved about and felt, and whence it evacuates sometimes many pints of urine and serum. Should doubt exist, it may be justifiable to inject a warm weak solution of Condy's fluid or warm boracic acid lotion through the catheter, and if more than a pint can be injected without meeting with any resistance, or if a sense of warmth over the belly be produced by it, or dulness appear above the pubes, with or without fluctuation, the fact of a rupture in the viscus becomes certain. If now the symptoms of acute peritonitis come on (general abdominal pain and tenderness, distension, vomiting, constipation, cessation of abdominal respiration, quickened pulse, pyrexia, etc.), the rupture is *intraperitoneal*. If, however, these symptoms do not quickly ensue, and in place of them there be pain limited to the pelvis, with swelling in front of the rectum, or reaching up above the pubes or along the fold of the groin, with fever, quick pulse, and dry tongue, the rupture is *extraperitoneal*, and has led on to *pelvic cellulitis*; this, if unrelieved, may lead to *peritonitis*. The bladder may be ruptured without fracture of the pelvis, by severe contusions of the hypogastrium, or with fracture of the pelvis (wound of the bladder), by muscular violence, during parturition, by over-distension, or as the result of disease.

If there be an induration in any part of the penis immediately following an injury it is produced by *extravasation of blood into the corpus spongiosum* or *corpus cavernosum*; if this be extensive, and involve the whole organ, it may cause "permanent chordee." The diagnosis of *contusion* and *rupture* of the *pregnant uterus* and *rupture of an ovarian cyst* is discussed on page 153.

Wounds of the pelvic viscera.—If from any wound of the penis or perinæum urine flow during the act of micturition, it shows that there is a *wound of the urethra*. Similarly the escape of urine from a wound over or above the pubes independently of micturition along with the signs of laceration of the bladder (*vide antea*) will indicate *wound of the bladder*. If there be an external wound of anus, or vulva, or vagina, or a history of a weapon of any kind having entered either of these canals, the finger must be passed gently into them, and their walls carefully explored; a rent in either of them may in this way be found. The onset of acute peritonitis will point to a *wound of the peritoneum*: if the bladder be found empty or containing only a little blood and urine, it will indicate *wound of the bladder.* (*Vide antea.*) The small intestines may be found prolapsed into the vagina. The escape of blood and liquor amnii from the wound, or protrusion of part of the fœtus or of the placenta, and hæmorrhage into the vagina, indicate *wound of the pregnant uterus.*

Foreign bodies in the rectum or vagina will be detected on digital examination; when recently introduced, the history of the case will lead to their detection; when long impacted, the fact of a chronic muco-purulent discharge, with pain, and, in the case of the rectum, tenesmus will suggest the necessity of an examination.

For *foreign bodies in the bladder, see* page 551.

Foreign bodies in the urethra.—If in the spongy portion, they may be felt by carefully passing the finger along the outside of the urethra, or they may be felt by a bougie, or seen by the endoscope. When deeper in, the finger in the rectum may detect them; or if not, on passing a full-sized silver catheter or bougie obstruction will be met with near the neck of the bladder, and the foreign body may be pressed back into the bladder, and thus detected.

CHAPTER XIII.

THE DIAGNOSIS OF THE SPECIAL INJURIES OF THE UPPER LIMB.

FULL directions for the diagnosis of wounds, sprains, and contusions are given in chapters ii. and iii. Here, therefore, we have to consider only the diagnosis of dislocations and fractures, and of any injuries liable to be mistaken for them. In approaching this question we would urge upon students not to rely upon any individual "test" symptom, but upon the rational signs of these injuries, and to make a systematic examination of the parts. Different teachers and surgeons recommend various methods of examination, and it matters little which of several the student adopts, provided only that the method be systematic, and that he follow it faithfully. We shall here, of course, mention only one of these methods of procedure.

In the large majority of cases the patient is able to point out the seat of injury; but this is not always the case, and the student must be particularly cautioned against omitting to examine all the parts of an injured limb, and all the limbs of a seriously injured person; for it not uncommonly happens that when one fracture or dislocation has been detected other similar injuries or sprains and contusions are quite overlooked, and the results of such negligence may be very serious.

Mode of examination.—When possible, the patient should be seated in a chair, and the surgeon standing behind him should place the forefinger of each hand on the suprasternal notch of the sternum, and passing outwards he should feel on either side the large inner ends of the clavicles, noting whether they are symmetrical or not; he should then run the ends of his fingers along the upper surface of each clavicle, quite to the point of the shoulder, and along the acromion and spine of the scapula to the posterior border of that bone, all this arch of bone being subcutaneous. Comparing the two sides, he observes particularly any break in the line of the clavicle or scapula, and any tender spot in the bony arch.

He should next proceed to examine the shoulder joint, to determine whether or not it is dislocated, or if there be a fracture near to it. Placing the hands flat upon the prominence of each shoulder, with the thumb resting on the point of the acromion, he must note whether the thumb or the hand is internal, whether he plainly feels the prominence of the upper end of the humerus beneath the hand, or whether he can press in the deltoid muscle, and feel through it the glenoid fossa of the scapula; these signs prove a dislocation of the shoulder, and search must then be made for the head of the bone below the clavicle, in the axilla, or, failing to find it there, below the spine of the scapula; then, with one hand grasping the head of the bone, let him rotate gently the elbow on the same side, and notice whether the head moves with the rest of the shaft, or not, and if there be crepitus.

By this examination any lesser degree of flattening of the natural prominence of the shoulder will have been noted; let the surgeon now place the points of his fingers in the groove between the pectoralis major and deltoid, and feel for the coracoid process, and press firmly upon that point of bone, and take special notice of acute pain, or crepitus, or mobility of the process so produced; then pass the ends of the fingers out round the shoulder to note any difference in the outline on the two sides. Gently raising the arm, place the fingers in the axilla, and feel the inner surface of the neck of the bone, first on the sound side, then on the injured, and note any projection, or if the head of the bone be too plainly felt. Then place the hand flat and rather firmly on the shoulder, and rotate the elbow, and feel for crepitus, noting as accurately as possible where the crepitus is produced. Finally, the hands should be passed over the back of the scapulæ below the spine, and any irregularity or tender line noticed, and then the angle should be seized in one hand, and an attempt be made to move it on the rest of the bone. Departures from the normal in these various respects will indicate a fracture about the shoulder.

The surgeon should then stand in front of his patient, and place the sound limb in exactly the same position as the injured one. There may be an obvious deformity, such as angular bend in the arm or fore-arm, or great projection of the point of the elbow, which shall at once declare a fracture or a dislocation; but even in such a case it is best to follow out a systematic examination, for it occupies but a few seconds, and may save from serious blunder. To examine the shaft of the humerus, place the thumbs on the inner side of the surgical neck of each humerus, and the fingers on the outer side, and run them down along the bone to the elbow, noting, of course, any want of symmetry, especially any sharp projection or irregularity, and any local tenderness; where either of these is detected, grasp the arm above it in one hand, and rotate the elbow with the other, and try to move the lower end of the bone laterally, or forwards and backwards, noting mobility in the length of the bone, crepitus, and whether the attempt produces sharp pain at the suspected spot. It may be well here to remark, that if on rotating the elbow distinct mobility or crepitus be obtained, and the place where they occur be detected, it is unnecessary and therefore wrong to repeat the act, or to try the effects of movement of the elbow in other directions.

Coming now to the elbow, the two joints should be taken into the palms of the hands with the forefinger resting on the tip of the olecranon, the thumb will then be placed on the outer epicondyle of the humerus and the middle digit on the inner epicondyle. The relative distance between and level of the olecranon and these two points of bone is to be noted, also whether the outline of the sigmoid notch of the ulna can be felt, or a gap in the line of the olecranon, whether the olecranon is more or less prominent on the injured side than the other, and whether flexion and extension of the joint are painless and free. The thumb of the left hand should then be placed on the outer condyle of the humerus, and the hand seized with the surgeon's right hand and gently rotated, when the rounded head of the radius should be felt rotating immediately below the condyle. If this movement be painful, and produces crepitus at the elbow, of course special note is to be made of it. Then each epicondyle is to be separately grasped, and an attempt made to move it on the rest of the humerus, the surgeon observing, so far as he can, the size of the fragment that he is able to move. Lastly, he should run the finger carefully along the olecranon to note any slighter irregularity in it that may have escaped notice before, or any tender spot, and, grasping the tip of the prominence, he should attempt to move it laterally, and should then notice how much of the bone, if any, is detached, and whether there is crepitus between the two fragments or not; the tendon of the triceps muscle should be followed down to its insertion into the ulna, and it will not then be possible to overlook a fracture of the olecranon, with drawing up of the upper detached fragment. It may happen that when the surgeon first sees his patient the part is so swelled that an exact diagnosis is impossible, he should endeavour to assure himself that there is no dislocation; extensive ecchymosis should be taken as strongly indicating a fracture.

Fracture of the shaft of both bones of the fore-arm is usually a very obvious accident, on account of the angular deformity of the limb at the site of the fracture. The whole length of the ulna can be plainly felt through the skin, and the finger should be run along its posterior border from the olecranon to the styloid process, and the radius should be similarly examined; as already mentioned, the head of the radius should be felt immediately below the outer epicondyle of the humerus at the bottom of a slight dimple in that situation; the shaft of the bone is covered by muscle, but the finger can plainly feel its outer surface the whole way down; its lower end and styloid process are easily felt, and compared with the same parts on the sound side. The hand should then be pronated and supinated, to determine whether the head of the radius moves with the lower end of that bone; by attempts at angular movements in the fore-arm, the solidity of the bones or the reverse may be shown.

The bones of the wrist being so subcutaneous any displacement at the joints or fracture with displacement of the fragments is easily detected by the eye and by the hand. The same is true of the fingers and thumb, the bones are all practically subcutaneous on the dorsum; the surgeon should, therefore, run his fingers along the dorsum of the metacarpal and phalangeal bones, and note any irregularity, and then grasping the extremities of each bone, one in either hand, should see if there be any mobility with crepitus.

Measurement of the limb is sometimes useful in diagnosis, and before going further it will be well to notice the best measurements to take, and the injuries that modify them. First, measure *from the inner end of the clavicle to the tip of the acromion;* this is not increased by any injury; it may be shortened by fracture of the clavicle with over-riding of the fragments, bending of the bone (greenstick fracture), or by dislocation of its outer end. Next, measure *from the tip of the acromion to the outer epicondyle* of the humerus, or *from the tip of the coracoid process to the inner epicondyle.* If lengthened, there is a dislocation of the shoulder. Shortening of the arm, as shown by this measurement, may be caused by dislocation of the shoulder, by fracture of the humerus, or by fracture with displacement downwards of either the acromion or the coracoid the process. Then measure *from each epicondyle of the humerus to the styloid process* of the same side; shortening of the outer line may be caused by dislocation of the radius at the elbow, or by fracture of the same bone; shortening of the inner line is similarly due either to fracture or dislocation of the ulna. In the wrist and hand measurements may be taken *from the tip of either styloid process to the base of the first and fifth metacarpal bone* respectively, shortening of this measurement indicating a dislocation of the wrist. A useful measurement is the *circumference of the shoulder*, taken by passing the tape under the axilla, and bringing its ends vertically up over the shoulder; dislocation of this joint increases this measurement by from one to two inches. The distance between the tip of the olecranon and either epicondyle of the humerus indicates the relative position of the ulna to these bony points.

Among many other "pathognomonic signs" may be mentioned this: when a flat rule or some similar body is placed with one end resting on the outer epicondyle of the humerus, and the other extremity on the prominence of the shoulder, its point should not touch the acromion, but should be separated from it about an inch; if, however, its upper end rest against the acromion, it shows that the upper end of the humerus is not occupying the socket of the scapula, in other words, that it is dislocated.

By this examination, which, when the surgeon is expert in his movements, can be very quickly conducted, we are able to decide whether there is any serious injury to the bones or joints, any fracture or dislocation;

and are also able to tell where the injury is, and to put it in one or other of these categories :

Fracture and dislocation of clavicle, acromion, or spine of scapula.
Dislocation of the shoulder.
Fracture of the shoulder.
Fracture of shaft of humerus.
Fracture of fore-arm.
Fracture or dislocation of elbow.
Fracture or dislocation of wrist.
Fracture or dislocation of fingers and thumb.

We will now discuss the diagnosis of the various lesions in each of these groups.

A. **Fractures and dislocations of the clavicle, acromion, and spine of the scapula.**—(1) If, in commencing the examination, the suprasternal notch be found narrowed, and the sternal end of the clavicle be felt to be on the top of the sternum, projecting strongly under the skin, and allowing its whole articular surface to be felt, it is a *dislocation of the clavicle upwards.* If, however, on passing the finger out from the suprasternal notch the end of the clavicle be not felt in its proper place, feel for it behind the sternum or in front, and, according to its position, it will be recognised as *dislocated backwards or forwards.* In all these cases there is no shortening of the measurement from the inner end of the clavicle to the point of the shoulder, and owing to the large size of the inner end of the bone, and its superficial position, the diagnosis is not difficult. When the bone is dislocated backwards there may be very great distress, owing to the displaced bone pressing upon the trachæa, the œsophagus, or the great vessels and nerves of the neck.

(2) On running the finger along the clavicle a distinct break in the line of the bone may be detected, one part of the bone being obviously separated from the other; this is most often met with a little to the outer side of the middle of the bone, the end of the

inner fragment projecting under the skin, the outer fragment being on a lower level; it may occur close to the inner end of the bone, when the outer fragment will, in most cases, be prominent, riding downwards and forwards over the inner. This sign will of itself suffice to indicate a *fracture of the clavicle*, and to localise it precisely. When the fracture is near the inner end of the bone, the facts that the inner extremity is felt in its right position on the sternum, that movement of the clavicle is attended with crepitus, and that the point of the shoulder is approximated to the inner end of the bone, will at once distinguish the injury from a dislocation of the bone, for which it might possibly be mistaken.

If on running the fingers over the outer flattened end of the bone, it be found that there is an angular projection backwards, that the shoulder has rolled forwards, and is approximated to the inner end of the clavicle, that over the bony projection there is pain and great tenderness, and especially when on rotating the elbow freely crepitus at this spot is detected, a *fracture of the acromial end of the clavicle* is to be diagnosed. Sometimes the angular deformity is upwards instead of backwards. There may, however, be no displacement of the fragments, and no deformity; but if, as the finger passes along the bone, at one spot the patient winces and complains of great tenderness, and when the shoulder joint is freely moved it causes pain at the same point, a *fracture of the clavicle without displacement*, or, as some prefer to call it, a *fracture opposite the coraco-clavicular ligaments*, is to be suspected; if crepitus can be obtained, the diagnosis becomes certain; but without that, or some slight irregularity in the bone, the diagnosis cannot be certain, unless in the course of a week or ten days slight thickening from callus at the spot clears it up. Where there is no displacement there is no shortening. When in an infant or young child, who has fallen on its shoulder, the middle of the clavicle is found projecting forwards or upwards, but the bone quite continuous, it being simply bent, and the bone is found shorter than the one on the other side, a *greenstick fracture of the clavicle* may be diagnosed. This can only be mistaken for the curve in the bone often seen in rickets. If, however, the bone can be straightened out again with more or less distinct crepitus, or if it become swelled along the curvature in a few days, there can be no difficulty whatever in the diagnosis. In rickets the deformity of the bone is the same on the two sides, and there will be other signs of the disease in the bones, teeth, etc. This fracture may, however, occur in a rickety child, and the surgeon must then be guided by asymmetry (the rickety curve being exaggerated by the fracture), by the marked local tenderness, by the crepitus if present, and by the swelling coming on or increasing for a day or two after the injury.

(3) The articulation of the clavicle with the scapula can always be felt as a slight projecting ridge. If, however, in place of this slight ridge there be, just internal to the point of the shoulder, a marked bony projection, it is a *dislocation of the scapula.* If the projection be continuous with the clavicle, and that bone be found lying upon the acromion, it is a dislocation *downwards.* As a very rare occurrence the acromion may be found lying on the clavicle, and projecting under the skin, dislocated *upwards.* In the latter case try to feel the coracoid process, as that has been described as lying above the clavicle. These injuries are sometimes called dislocations of the acromial end of the clavicle.

(4) When there is bruising, swelling, and pain over the top of the shoulder, examine carefully the line of the acromion to detect an irregularity, or the detachment and displacement downwards of a fragment

in front of the outer end of the clavicle, or crepitus on forcibly raising the elbow; inability to abduct the shoulder owing to a sharp pain referred to the end of the acromion, as well as slight flattening of the shoulder, should make the surgeon strongly suspect a *fracture of the tip of acromion*, but it is only when he detects the fragment displaced and movable that the diagnosis is certain.

If, on running the finger still farther back along the acromion, a gap be found in it behind the point of the shoulder, if the shoulder be flattened and dropped, and if on raising the elbow this latter deformity be corrected, and the acromion be then found to be raised to the level of the spine of the scapula, crepitus thus being obtained, a *fracture of root of acromion* has occurred. Where there is no crepitus, or only soft friction to be obtained, it is to be regarded as *diastasis of the acromion*, or separation of the epiphysis. Care must be taken to ascertain that the mobility of the acromion is not a natural condition, and present on the uninjured side also.

If on running the finger along the spine of the scapula, a depression or sharp projection in it be detected, grasp the bony prominence, and attempt to move it while holding the rest of the scapula firm in the other hand; if this be possible, and especially if crepitus be at the same time noticed, a *fracture of spine of scapula* is to be diagnosed. This injury is a very rare one.

B. **Dislocations of the shoulder.**—The surgeon having found that there is a dislocation of the head of the humerus, the diagnosis will be made complete by his determining where the head of the bone is now lying. While comparing the two shoulders, the possibility of a bilateral dislocation of the shoulder must be borne in mind. The globular head *of the humerus* should first be felt for in front, filling out the groove between the deltoid and pectoral muscles, obscuring the coracoid process, and forming a rounded prominence, moving when the arm is rotated; if it be found there, the dislocation is *subcoracoid.* Some would draw a distinction between subcoracoid and intracoracoid; in the former the arm is rotated out, in the latter the arm is rotated in. This form of dislocation is much the most frequent, and the surgeon must remember that in it, when the arm is raised, the head of the bone can be plainly felt in the axilla. The length of the arm may be unaltered, a little shortened, or a little lengthened.

If, on examining the front of the shoulder, the tip of the coracoid process can be plainly felt, but a rounded prominence is seen and felt under the pectoral muscle, one or two fingers' breadth below it (the prominence being shown to be the head of the humerus by its outline, and especially by its rotating with the shaft of the bone), and if the head of the bone be plainly felt in the axilla, bulging down its floor, even without raising the arm, the elbow being directed far away from the side, the dislocation is *subglenoid.* Subcoracoid dislocations are often spoken of as dislocations into the axilla, and are mistaken for subglenoid, owing to the ease with which the misplaced bone can be felt in the axilla, especially when the arm is raised. A subglenoid dislocation is rare, and is only to be diagnosed when there is a distinct interval between the coracoid process and the head of the humerus, and when the whole globe of the head can be readily felt in the axilla. The arm is usually lengthened in this displacement; it has, however, been described as shortened. Mr. Hulke has described two cases of this dislocation, in which the arm was placed vertically up by the ear of the same side, the head of the bone ng out and projecting from the axilla; he has d this particular variety *luxatio erecta.*

If the head of the bone be found lying below the clavicle internal to the coracoid process, and out of reach of the fingers passed into the axilla, the dislocation is *subclavicular*. If the head of the humerus cannot be found in front, feel for it behind, below the acromion and spine of the scapula; if detected there, and it will be easily known by its rounded shape and its moving with the shaft of the bone, it is a *subspinous* dislocation.

Mr. Holmes has drawn attention to cases where the head of the humerus is found forced up under the skin between the deltoid and pectoral muscles, forming a very marked and unmistakable projection at the top of the shoulder; this form is called the *supra-coracoid* dislocation, and is always associated with fracture of the acromion or of the coracoid process. It is occasioned by severe violence applied to the elbow forcing the humerus upwards against the scapula.

If, in reduction of the dislocation, crepitus is obtained, and the head of the bone easily slip out of place again, and the surgeon be able to assure himself that there is no fracture of the humerus or of the coracoid or the acromion process, he should diagnose a *fracture of the glenoid cavity*, an injury never met with apart from dislocation of the joint.

C. **Fractures of the shoulder.**—The surgeon having decided that there is no fracture or dislocation of the claviculo-acromial arch, and that the upper end of the humerus still occupies the glenoid cavity of the scapula, finds that there is deformity about the shoulder or crepitus on rotating the arm or on manipulating the scapula; he therefore decides that there is a fracture of the bones entering into the shoulder, either of the upper end of the humerus or of the scapula.

Let him first grasp the rounded head of the humerus immediately below the acromion, and with the other hand

crepitus be obtaine
of the head.
ts [illegible] end of the hun
pr [illegible] the axi
as [illegible] of the low
fel [illegible] elbow aga
hu [illegible]
tio [illegible]
th [illegible]
w [illegible]
fe [illegible]
si [illegible]
to [illegible]
w [illegible]
a [illegible]
b [illegible]

d [illegible]
n [illegible]
l [illegible]

to rotate with the shaft, and yet the movement occasion crepitus, the surgeon should next examine carefully the great tuberosity of the humerus, and try to grasp it between the finger and thumb and to move it on the rest of the bone, or notice whether the shoulder is broadened by the fragment being drawn out and back. By these signs, when obtained, a *fracture of the tuberosity of the humerus* will be recognised. This injury may complicate a dislocation of the head of the bone, and is said to be produced by muscular action as well as by direct violence.

When, however, on attempting to grasp the upper end of the bone and to rotate the elbow, the surgeon finds that this upper end moves with the shaft, but is not the rounded head of the bone, and that the deltoid is flattened and the acromion rather prominent, he should at once feel for the head below the coracoid process and in the axilla, and if he find that it does not move when the shaft is rotated (the manipulation perhaps eliciting crepitus), he will readily recognise a *fracture of the neck of the humerus with dislocation of the head.* The head of the bone has been found on the dorsum of the scapula. In this injury the arm is notably shortened, and the deformity of the shoulder is striking, and often at first suggests a simple dislocation of the bone, until the surgeon discovers that he cannot force his hand down to the glenoid cavity, that the arm is less rigid than in dislocation, and that the head of the bone does not move with the shaft.

If, however, rotation of the elbow cause crepitus at the shoulder, but the head and neck of the humerus are found to be entire and to move with the shaft of the bone, the surgeon should notice whether the limb is lengthened and the acromion a little prominent; if so, and if on simply raising the elbow this lengthening and prominence of the acromion are corrected and at the same time crepitus is elicited; and further, if rotate the elbow; if now rough crepitus be obtained, and the shaft move independently of the head, it demonstrates a fracture of the upper end of the humerus. If with the fingers pushed up into the axilla a projection inwards of the upper end of the lower fragment be detected, or on rotating the elbow again the line of the fracture is made out running below the tuberosities, it is a *fracture of the surgical neck of the humerus.* These cases usually occur in elderly people; the shoulder preserves its roundness, and the rotation of the upper fragment may even increase its normal prominence, and the lower fragment may be displaced inwards considerably, or in other cases not at all. Where there is marked displacement the limb is shortened, and the axis of the arm is directed down and out.

If, however, the finger in the axilla find the surgical neck of the bone entire, and still there be crepitus in the upper end of the bone, with slight flattening of the shoulder, and especially if, when the arm is abducted and rotated, the head be felt not to move with the shaft, or the breadth of the upper end of the bone be found increased, *fracture of the anatomical neck of the humerus* is to be diagnosed. This injury also occurs in old people, and its diagnosis is often attended with difficulty.

If the patient be under the age of twenty years, and the shaft of the bone be found to move independently of the upper end, with distinct, or indistinct and soft crepitus, and especially if the upper end of the shaft of the humerus make a pointed prominence on the front of the shoulder below the coracoid process, it is a *separation of the upper epiphysis of the humerus.* This injury may be met with in infants at birth, or at any age up to twenty. The displacement when present is very characteristic.

If, however, the upper end of the bone be found to rotate with the shaft, and yet the movement occasion crepitus, the surgeon should next examine carefully the great tuberosity of the humerus, and try to grasp it between the finger and thumb and to move it on the rest of the bone, or notice whether the shoulder is broadened by the fragment being drawn out and back. By these signs, when obtained, a *fracture of the tuberosity of the humerus* will be recognised. This injury may complicate a dislocation of the head of the bone, and is said to be produced by muscular action as well as by direct violence.

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But if there be some slight flattening of the shoulder, and a little shortening of the arm, with pain, and some deformity about the upper end of the humerus, while the head of the bone is found to be in the glenoid cavity and to move with the shaft of the bone, an *impacted fracture of the neck of the humerus* is to be diagnosed. This injury is sometimes succeeded by a slow and gradual downward displacement of the head of the bone, so that months afterwards the upper end of the humerus may be found in the glenoid cavity, and the head of the bone projecting in the axilla below its socket.

Having assured himself as to the condition of the humerus, the surgeon should next feel the coracoid process, and notice whether the distance between its tip and the clavicle is increased; he should grasp it, and try to move it on the rest of the scapula, noticing if crepitus, or acute pain be caused by the attempt, and also if, when the patient attempts to bend the elbow, it cause pain at the site of this process. If the process be movable, it demonstrates the existence of a *fracture of the coracoid process.* If met with in a child, and the crepitus be absent or soft, these signs would indicate separation of the epiphysis.

To examine the body of the scapula, the arm should be drawn as far forwards as possible, when the surgeon is able to trace with his fingers the outline of the bone; he should specially notice any irregularity of the vertebral border of the bone, or depression of the infraspinous fossa, or displacement forwards and upwards of the lower angle. If the shoulder be now placed as far back as possible, the vertebral border projects behind, and the surgeon can grasp it and obtain crepitus, or examine its outline still more accurately. By these means a *fracture of the body of the scapula* may be recognised. This injury most commonly extends across the bone below the spine, but it may be limited to the thin central part of the bone, and not implicate either border, being a fissured depression; or the fracture may detach either the upper, or more often the lower, angle of the bone; in the latter case the teres major draws the fragment up and forwards towards the axilla.

Mention may be made here of cases in which the arm is found to be fixed in the abducted position; but the head of the humerus occupies the glenoid cavity, and there is no fracture to be made out; but when the surgeon flexes the elbow and rotates the arm, he feels something slip, and then finds the deformity cured and all the rigidity gone, the accident is supposed to be *dislocation of the tendon of the biceps* from the bicipital groove.

D. **Fracture of the shaft of the humerus.**—This injury is readily recognised by the deformity in the arm (often an angular bend forwards or to one side), by mobility in the length of the bone, and by crepitus. Care must be taken to ascertain not only the exact position of the fracture, but particularly the direction in which displacement occurs, and whether the radial pulse is the same on the two sides, and whether there is any anæsthesia or paralysis of the fore-arm or hand; as the vessels and nerves of the arm lie so close to the bone, they are liable to be injured both by the fracturing force and by projecting angles of the bone, and it is important to recognise the fact at the time.

E. **Fractures and dislocations of the elbow.**—The fractures and dislocations about the elbow joint are very numerous, and their diagnosis is extremely important, as unless all displacement is corrected, the function of the joint may be permanently interfered with. The surgeon should stand in front of his seated patient, and grasping the two elbows in his palms, place his thumbs on the external epicondyles, his middle fingers on the internal epicondyles, and his forefinger tips on the points of the olecranon processes. The relative position of these three bony prominences is first to be ascertained. When the joint is bent the olecranon sinks below the epicondyles, when the elbow is straight it lies in a line with them. Having observed whether the relation of these three bony points is altered or unaltered on the injured side, the surgeon should next feel whether the head of the radius is lying immediately below the external epicondyle. By this means this large group of injuries will be divided into four classes.

(1) **The relation between the olecranon and both epicondyles is altered.**—The surgeon must particularly notice what the alteration is, whether the olecranon is simply raised, or displaced backwards, to either side, or forwards; and if the head of the radius follow the ulna in its displacement.

(*a*) **The tip of the olecranon is displaced upwards,** and at the same time is found to be movable laterally; when the elbow is extended the fragment may be rubbed against the upper end of the ulna, producing crepitus. These signs, of course, indicate a *fracture of the olecranon with displacement.* The patient will complain of pain and inability to extend the elbow, and there will be swelling and ecchymosis.

(*b*) **The olecranon is displaced directly backwards,** the distance between it and each epicondyle is much increased, and the point of the elbow projects strongly behind, while the head of the radius is felt at the back of the outer condyle of the humerus. These signs unmistakably indicate a *dislocation of the radius and ulna backwards.* The outline of the greater sigmoid notch of the ulna will probably be plainly felt at the back of the joint, and the tendon of the triceps muscle will stand out at the back of the arm above the olecranon. The distance between either epicondyle and the corresponding styloid process will be diminished, the joint will be rigid in the flexed position, and there will be a rounded prominence across the front of the bend of the elbow formed by the lower end of the humerus covered by the brachialis anticus muscle. If the deformity be easily reduced, but at once recur on removing the traction upon the fore-arm, and if when reduced flexion of the joint elicit crepitus, there is a *fracture of the coronoid process;* possibly the detached piece of bone may be felt at the front of the joint, and may be found movable from side to side. If the head of the radius be found occupying its normal position, and the length of the fore-arm on the outer side be unaltered, it shows the injury is a *dislocation of the ulna backwards;* while if the head of the radius be found lying on the front of the epicondyle, the injury is a *dislocation of the ulna backwards and of the radius forwards.* These last two dislocations are very rarely met with.

(*c*) **The olecranon is displaced forwards, its prominence at the back of the joint being lost,** and the head of the radius is felt separated from the external condyle and below it, while the distance both by the fracturing force and by projecting angles of the bone, and it is important to recognise the fact at the time.

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(*c*) **The olecranon is displaced forwards, its prominence at the back of the joint being lost,** and the head of the radius is felt separated from the external condyle and below it, while the distance from the epicondyle to the styloid process is increased on each side of the fore-arm; the injury is a *dislocation forwards of the radius and ulna.* If the olecranon be felt resting against the lower end of the trochlea, the dislocation is partial; if, however, the olecranon fossa and the lower end of the trochlea can be plainly felt at the back of the joint, the dislocation is complete; either form of injury is very rare.

(*d*) **The olecranon is displaced inwards,** filling up the hollow behind the internal epicondyle, and so masking the latter, while the external epicondyle is very prominent, and the head of the radius is not immediately below it, but also displaced inwards, with the length of the fore-arm little or not at all altered; these signs point to *dislocation of radius and ulna inwards.* If, however, at the same time that the olecranon is displaced inwards, it also projects back, being more than normally prominent behind, and the head of the radius is felt resting against the back of the trochlea, while the length of the fore-arm is a half to one inch shorter than on the uninjured side, the injury is *dislocation of the radius and ulna backwards and inwards.*

(*e*) **The olecranon is displaced outwards,** covering the external epicondyle, the head of the radius projects strongly under the skin, and on the inner side of the joint the internal epicondyle is very prominent, so that the lateral width of the joint is greatly increased, there is a *dislocation outwards of radius and ulna.* If the olecranon be prominent behind, and the radius project on a level posterior to the external epicondyle, and the fore-arm be shortened, the injury is a *dislocation of radius and ulna backwards and outwards.*

(*f*) **The width between the epicondyles is increased;** each of these processes is movable independently of the other with crepitus. These signs indicate an *intercondyloid fracture of the humerus*, in which with a transverse or oblique fracture across the lower end of the shaft there is combined a vertical fissure of the lower end of the bone separating it into two fragments. This fracture is the result of severe direct injury, is usually attended with very marked deformity of the joint, and is not unfrequently compound. The olecranon may be raised above its normal position and sunk in between the displaced lateral fragments of the humerus.

(2) **Relation of internal epicondyle and olecranon normal, olecranon above external epicondyle,** and the lateral distance between the two increased. When this deformity occurs, and is corrected by simple traction upon the fore-arm, and with the occurrence of crepitus; and, if a sharp projection is felt in the internal supracondyloid ridge, it shows that there is a *fracture through internal condyle of humerus*, with riding of the fragment up and in carrying the ulna with it; generally in these cases the *head of the radius is dislocated backwards*, and is felt on the back of the humerus, and then the outer side of the fore-arm is shortened, but not the inner.

(3) **Relation of external epicondyle and olecranon normal, distance between internal epicondyle and olecranon increased.**—This deformity may be due to displacement of either the olecranon or the internal epicondyle. If the epicondyle be movable on the shaft of the humerus, and the movement give crepitus, while the point of the elbow is not unduly prominent, the injury is a *fracture of internal epicondyle.* If the internal epicondyle, on the other hand, be immovable, but the point of the elbow be too prominent behind, and the movements of the joints are preserved, while drawing forwards the fore-arm corrects the deformity altogether, at the same time eliciting soft crepitus, and when the traction force

is removed the deformity recur, there is a *separation of the lower epiphysis of the humerus*, the internal epicondyle remaining attached to the diaphysis. This accident only occurs before the age of sixteen years.

(4) **The relation between the olecranon and the epicondyles is unaltered.**

(*a*) Feel whether the head of the radius is in its normal situation below the external epicondyle, if not, feel for it in front of that condyle under the swell of the supinator longus, or resting on the back of the bone, or it may be felt and seen very prominently under the skin, lying on the outer side of the epicondyle. In either of these cases the length of the inner side of the fore-arm is normal, while on the outer or radial side it is shortened; the movements of the joint are restricted, and in the forward displacement of the bone the elbow can only be flexed to a right angle. These signs will clearly indicate a *dislocation of the head of the radius forwards, backwards*, or *outwards.*

If, however, the head of the radius occupy its normal position below the external epicondyle, there is no dislocation present, and the surgeon must then examine carefully for fracture of the various bones. He should first notice whether the line of the humerus is normal, or whether there is any displacement of the elbow backwards, and then grasping either condyle try to move it separately. Having satisfied himself as to the condition of the humerus, the finger should be run very carefully along the olecranon process, and any irregularity or very tender spot noticed, and then seizing the tip of the process an attempt to move it should be made, and crepitus felt for. Next, placing the thumb of one hand on the head of the radius, with the other hand rotate the fore-arm, and notice whether the head moves with the rest of the bone, *or whether the* movement causes crepitus at the neck, the head being immovable Lastly, pressing upon the head see if any point of it be movable, or whether the pressure cause crepitus.

(*b*) The elbow is too prominent behind, and there is a rounded projection of the front of the arm a little above the fold of the elbow; the joint is not locked; the relation of the bony parts of the elbow is normal, and the length of the fore-arm is the same on each side of the two limbs; the deformity is corrected by simply drawing the fore-arm forwards, and this movement gives crepitus; when the traction ceases the deformity at once recurs. On running the finger down the supracondyloid ridges, a sharp projecting point of bone, or a "break" in its line, may be detected. These signs clearly indicate a *transverse fracture of humerus above the epicondyles.* When occurring in children under sixteen years of age, the deformity is generally less marked, and the crepitus is soft; the signs then indicate a *separation of the lower epiphysis of the humerus.*

(*c*) If either epicondyle be found movable, the movement giving rise to crepitus, it of course proves the existence of a fracture; this injury may or may not be accompanied with displacement of the fragment. The surgeon must notice, as far as he can, the size of the fragment, and whether the fracture simply detaches the epicondyle or runs up higher into the supracondyloid ridge, and into the joint; in this way *fracture of a condyle or epicondyle* may be diagnosed. Fracture of the internal condyle, with displacement of the fragment up and in, with dislocation of the radius backwards, has already been mentioned. The corresponding fracture of the outer condyle may be attended with displacement of the fragment outwards, upwards, or backwards, with or without dislocation of the bones of the fore-arm outwards.

(*d*) If a part or the whole of the olecranon be found movable on the rest of the ulna, with crepitus, the surgeon will diagnose a *fracture of the olecranon without separation.* This injury may be attended with some slight irregularity of the bone, and certainly with morbid tenderness over the line of fracture; this variety is more common than the fracture with separation.

(*e*) If, on rotating the fore-arm, the head of the radius be found not to move, and crepitus be felt just below it, a *fracture of the neck of the radius* may be diagnosed.

(*f*) If, on rotating the fore-arm, crepitus be felt just below the outer epicondyle, and be also elicited by pressure on the head of the radius, and especially if any part of this bony process be felt to be movable, this will be evidence of *fracture of the head of the radius.*

(*g*) If the presence of crepitus on moving the elbow show that there is a fracture, but all the bony points of the joint are in their normal relation and not detached, and further if there be a deviation in the line of the limb at the elbow joint, or a lateral movement there with crepitus, a *fracture of the articular process* may be diagnosed. This injury is very rare.

F. **Fracture of fore-arm.**—Either of the bones may be broken singly, but the fracture of the two bones together is more common; "greenstick fracture" is said to be more frequent in this situation than in any other. The signs of fracture are the common ones of pain, swelling, usually very marked deformity, mobility, and crepitus. The posterior edge of the ulna is subcutaneous in its whole length and may therefore be easily examined; the continuity of the radius may be shown by observing whether the head of the bone follows the movement of the wrist in pronation and supination.

(1) If there be marked deformity in the limb, a bend to either side, forwards or backwards, occurring as the result of a fall on the hand or a twist of the fore-arm in a child or young person, and there be no mobility in the length of either bone, and no crepitus be obtained, the injury is a *greenstick fracture;* this diagnosis will be confirmed if the surgeon be able to straighten out the bones again.

(2) An angular deformity of the fore-arm with mobility in its length and crepitus, will indicate *fracture of the radius and ulna.*

(3) If there be pain and swelling over the ulna, and on running the finger along the subcutaneous edge of the bone a very tender spot is found, and here mobility and crepitus, with or without irregularity of the bone, are detected, while the length and general outline of the fore-arm are unaltered, and the radius is found to be entire, the signs will point to a *fracture of the ulna.*

(4) Similarly, if the ulna be felt to be entire, but on rotating the wrist crepitus is obtained, and the head of the radius is found not moving with the lower end, a *fracture of the radius* is to be diagnosed. A depression in the line of the bone as felt from the outer side, or the position of greatest pain and tenderness, will mark the seat of the fracture. This fracture is usually attended with displacement of the lower fragment inwards, and abduction of the hand; it is most common in the lower third of the bone.

G. **Fractures and dislocations of the wrist.**—In this region the commonest accident is fracture of the lower end of the radius, known as *Colles' fracture;* in addition, and rarely, are observed separation of the lower epiphysis of the radius, fracture of the styloid process of the radius, dislocation of the wrist, of the lower end of the radius from the ulna, and of some of the carpal bones. Deformity is the sign by which these injuries are diagnosed, and the position and shape of projections and depressions, together with alterations in local measurements and in the axes and planes of the hand and fore-arm, are the signs by which a diagnosis has to be made.

(1) If there be a prominence on the back of the wrist above the styloid process of the radius, which is itself on a horizontal level with or above that of the ulna, while corresponding to the dorsal projection there be a slight hollow on the palmar aspect, and above that a rounded prominence over the radius, and the styloid process of the ulna appear too prominent, and with a marked groove or depression below it, the injury is a *Colles' fracture.* The distance from the styloid process of the radius to the base of the first metacarpal bone is the same on the two sides, but that from the styloid process to the external epicondyle of the humerus is shortened on the injured side. If this deformity be met with in a young person under eighteen or twenty years of age, and it be reduced with a soft grating sensation on extension of the hand, it is a *separation of the lower epiphysis of the radius.* In elderly adults the fracture is usually impacted and mobility and crepitus are not obtained.

(2) If there be a prominence just above the dorsum of the wrist, and the whole hand be carried back, but is in a straight line with the fore-arm (not abducted), and each styloid process is approximated to the epicondyle of its own side, and situated at a normal distance from the metacarpus, the injury is a *fracture of the lower end of radius and ulna;* in this fracture there is generally mobility and crepitus, and the break in the line of the ulna is obvious.

(3) If, however, the prominence on the back of the wrist have a distinct convex upper margin, and *the styloid processes* keep their normal relation to

each other, that of the radius being below that of the ulna, with the measurement of the length of the fore-arm unaltered, while the distance between either styloïd process and the base of the metacarpus is considerably shortened, the injury is a *dislocation backwards of the carpus;* this diagnosis will be confirmed if the deformity be corrected by extension, the bone slipping in with a snap, but without any crepitus being felt.

(4) If, however, the prominence on the dorsum of the wrist be formed by the two styloid processes and concave extremities of the radius and ulna, while immediately below this is a marked depression, the hand being on a lower level than the fore-arm when held out palm down, and a projection be found on the palmar side opposite the fold of the wrist, and the measurements are the same as in the last case, it is a *dislocation forwards of the carpus.* Dislocation of the wrist is a very rare accident, especially the displacement of the carpus forwards.

5. If the lower ends of the radius and the ulna project on the back of the wrist, the hand being on a plane anterior to that of the fore-arm, with a palmar prominence opposite the fold of the wrist, and the styloid process of the radius be above its usual position, approximated, that is, to the external epicondyle, but not separated from the first metacarpal bone by a longer distance than on the opposite side, the injury is a *fracture of lower end of radius, with displacement forwards.* This is a very rare injury.

(6) If the lower end of the radius be found very prominent on the back of the wrist lying over the end of the ulna, and pronation and supination be impossible or very limited, the diagnosis should be *dislocation of lower end of radius backwards.* Should the prominence on the back of the wrist be formed by the lower rounded end or head of the ulna, which is

very prominent under the skin resting on the radius, it is a *dislocation forwards of the lower end of the radius.* These dislocations are both of them quite uncommon; they are sometimes spoken of as dislocations of the ulna in the opposite direction. In either case the length of the fore-arm, and the distance between the styloid processes and the bones of the metacarpus, are unaltered. Pronation and supination of the hand are very limited and painful.

(7) If a rounded projection be felt on the back of the carpus about its centre, firm and unyielding, and the movements of the wrist-joint are found to be free, a *dislocation backwards of the head of the os magnum* may be recognised. Occasionally the whole bone is displaced backwards, or one of the other bones, as the semilunar or pisiform bone, may be felt displaced. The position and the shape of the bony prominence will determine the diagnosis.

(8) If there be no obvious deformity, such as the above fractures and dislocations produce, the surgeon should seize the styloid process of the radius, and try to move it on the rest of the bone. If he find it movable, and the movement occasion crepitus, he will have no difficulty in diagnosing a *fracture of the styloid process of radius.* Similarly, mobility with crepitus are the signs of a *fracture of the styloid process of the ulna.*

(9) If free movement of the wrist-joint be painful and attended with crepitus, and yet neither of the styloid processes be movable, the injury is probably a *fracture of the carpus.*

(10) Pain in moving the wrist persisting for some days, and attended with marked tenderness along a vertical line over the end of the radius, and subsequently some slight thickening along this line, have been held to warrant the diagnosis of a *fissure of the lower end of the radius.*

H. **Fractures and dislocations of the metacarpus and phalanges.**—These bones are so subcutaneous that any irregularity in their contour is easily detected. The examination is to be made first by running the fingers along the bones of each digit to note irregularity, then by grasping the two extremities of each bone to attempt to obtain mobility in its length and crepitus, and lastly by pressing the end of each finger up towards the wrist, to observe whether it produces acute pain or crepitus. A convenient way of ascertaining whether there is any shortening is to place the two hands together palm to palm, when any shortening of a finger or the thumb is at once rendered obvious.

(1) *Dislocation of metacarpal bone of thumb* may occur backwards, or, more rarely, forwards. It is recognised by approximation of the base of the bone to the styloid process of the radius, and by the marked prominence the base of the bone forms on the dorsum or palm of the hand. It is distinguished from fracture with displacement by the position and shape of the prominence, and by the absence of crepitus. *Either of the other metacarpal bones may be partially dislocated backwards,* and form a prominence on the back of the hand; the bone can be pressed into place when the corresponding finger is extended.

(2) If a metacarpal bone is found to be deformed, and movement in its length is obtained, or crepitus, or the finger is found shortened, and pressure upon it up towards the wrist causes acute pain at one spot in the metacarpus, or is attended with crepitus, a *fracture of the metacarpus* may be diagnosed.

(3) Irregularity, mobility, or crepitus, or all these three signs together enable the surgeon to recognise easily *fracture of a phalanx.*

(4) Stiffness and pain at a phalangeal joint with shortening of the digit, and great increase of the

antero-posterior diameter of the joint, point to *dislocation of a phalanx.* The outline of the bones can be so plainly felt that there is no difficulty in deciding upon the direction of the displacement. All phalanges are most frequently dislocated backwards; those of the thumb may be dislocated forwards.

CHAPTER XIV.

THE DIAGNOSIS OF THE SPECIAL INJURIES OF THE LOWER LIMB.

A LARGE proportion of the fractures and dislocations of the lower limb are at once rendered apparent by the obvious deformity they occasion; in others the seat of pain marks the position of the injury, and the ready detection of crepitus enables the surgeon at once to diagnose a fracture; only in a small minority of cases is there grave difficulty in arriving at a conclusion as to whether a patient has sustained a fracture or a dislocation, and these are mainly met with in injuries of the hip-joint where the difficulty arises from the thickness of the soft parts overlying the articulation. In examining an injured limb, the surgeon should first of all expose the two limbs thoroughly, and look carefully to see if there be any deformity, an alteration in the axis or position of the limb or of any of its parts, an unusual prominence or depression or obvious alteration in its length, the existence of which will indicate both the fact of a lesion of the skeleton of the part, its situation, and in many cases its nature. Next, the limb should be examined by the hand, and here again it should be compared with the sound member. One hand should be placed on the outer side of each hip just below the crest of the ilium, and the top of the great trochanter of the femur felt for. In this way any marked alteration in the position and shape of this process will be detected. The fingers should be passed round behind it towards the buttock to explore that region, and to note any difference between the two sides, and particularly whether the head of the femur can be felt there. Next, the fingers should be gently pressed into the hollow of the groin, and any difference in the resistance encountered on the two sides, or any marked pain produced, noticed. The hands run down along the thighs will detect any great deformity in the shafts of the femurs, but in muscular persons these bones are so thickly covered that a slight alteration in the contour of the bone may readily escape notice. The marked local tenderness, which has been often before referred to in connection with fractures, will in this case, too, be of considerable value in this manipulation in arresting the surgeon's attention in cases where there is no obvious deformity. The bones of the knee, being more subcutaneous, can be more thoroughly examined. The joint should first be grasped laterally to determine whether there is any increase in its width, and then the hand may be passed down from the femur to the tibia, and the relative position of these two bones carefully compared on the two sides for the purpose of deciding whether the tibia is displaced forwards, backwards, or laterally upon the femur, or rotated upon its own axis. Then the patella should be felt for, and as this bone is wholly subcutaneous, its surface is easily felt and its position noticed. It may then be grasped above and below, and an attempt made to move one part independently of the other. Failing this, a similar attempt may be made upon the lateral halves of the bone. The head of the fibula resting against the outer tuberosity of the tibia should then be examined. And now the surgeon will pass his fingers down along the crest and subcutaneous inner surface of the tibia, and notice carefully any irregularity in the bone, or marked tenderness. By somewhat firmer pressure the outline of the fibula can be similarly explored. At the ankle joint the bones again become wholly subcutaneous, and the breadth of the malleoli and their outline can be easily compared on the two sides. The skeleton of the foot is readily felt from the dorsum, and any displacement of the bones either at the joints or elsewhere can be determined. The bony points to be specially felt for are the prominence of the heel, the tubercle of the scaphoid, and the projection of the base of the fifth metatarsal bone.

The examination of the general conformation and relations of the bones by the hand will add much to the knowledge obtained by the eye alone. Where such examination has led the surgeon to suspect the existence of a fracture, he will seek to determine this point at once by trying to obtain mobility or crepitus in the length of the bone. As in all other cases, so here, the utmost gentleness should be observed in making the necessary manipulations. The limb should be firmly grasped close above and below the suspected spot, and at first an attempt should be made to obtain movement or crepitus with quite slight force ; this may be gradually increased when it is found that the bone resists, or at once discontinued as soon as any crepitus is felt. In some places the manipulation is a little different. At the upper part of the thigh it is impossible to grasp the limb in this way, and the plan adopted is for the surgeon to place his hand flat over the trochanter, and for an assistant to seize the foot and gently rotate the whole limb, the surgeon observing whether there is any crepitus, and also whether the trochanter moves with the shaft of the femur, simply rolls around its own axis, or moves in a circle as large as that on the sound side. This manipulation, too, must be carefully and gently executed, lest an impacted fracture should be unimpacted. At the knee, when the bone is broken, the parts of the patella may be separately taken hold of, and moved one upon the other, or either condyle of the femur may be movable in an antero-posterior direction upon the rest of the bone. At the ankle either malleolus may be moved in a similar manner. And I may here pause to point out that fractures of the malleoli are often overlooked from want of care in this manipulation, the injury being attributed to a sprain. Whenever there is marked local pain over either malleolus, and especially when to this is added acute tenderness to pressure at the same spot, the part of the bone below this spot should be seized, and a careful attempt made to move it upon the rest of the bone; failing that, the limb should be grasped with the thumb or fingers firmly pressed upon the painful spot, and with the other hand the foot should be flexed and extended and rocked laterally; by one or other of these manipulations crepitus will be obtained if there is a fracture.

The examination by the hand also gives other valuable information. Thus, in the thigh, it will determine the tension of the strong outer band of the fascia lata (ilio-tibial band). At the knee, the position, tension, or continuity of the ligamentum patellæ, and the state and position of the hamstring tendons will be noticed; while at the ankle the tendons behind each malleolus will be felt for, as these are liable to be displaced forwards. Having done this, or before attempting to elicit crepitus where fracture is not suspected, the surgeon will proceed to compare the two limbs by *measurement*. This is a most important part of the examination, and should never be omitted, unless the diagnosis is absolutely certain without it, as in transverse fracture of the patella, for example; and at the same time great care must be taken that the measurements are really between the same points on the two sides, or the surgeon may be seriously misled instead of being helped by his results. It is necessary also to place the two limbs in the same position when measuring them, and for this purpose the sound limb, which can be moved without occasioning pain, must be brought into the position assumed by the injured member. The best position for taking these measurements is the patient lying flat on his back, with the limbs extended straight and parallel, and the pelvis so placed that a line drawn from one anterior superior iliac spine to the other cuts a median vertical line at right angles. This latter line can be easily obtained by having one end of a piece of string held between the patient's central incisors and drawing the other end down so that the thread lies over the umbilicus and the symphisis pubis.

The following measurements will be found of use:

1. **The length of the limb from the anterior superior iliac spinous process to the tip of either malleolus.**—This gives the length of the entire limb, and alterations in it afford no guide as to the site of the deforming lesion, which may be in the hip, thigh, knee, or leg; it, of course, affords no information as regards the foot. When the measurement differs on the two sides, the surgeon must then proceed, by other sectional measurements of the limb, to determine where the deformity actually exists. It has of late years been shown as a normal occurrence that a good many people have the lower extremities unequal in length, and generally without any knowledge of the fact on

their part, and this inequality may amount to as much as an inch, or even more. But sectional measurements always show that this want of symmetry is not limited to any one section of the limb, but is shared by both the thigh and the leg. Therefore it is not enough to find simply that one lower extremity is longer or shorter than the sound one ; it is necessary further to show that this inequality exists in one particular section of the limb. It must also be borne in mind that if one limb is an inch longer than the other, and it receives an injury (a fracture, for instance), it may be shortened by just so much, and the tape would then show the two limbs to be of the same length. This would be a circumstance of very exceptional character, but its mere possibility must arm the surgeon against being misled by it. It must also be remembered that previous injuries, diseases, or operations may have altered the length of a segment of the limb. In conclusion, then, although this measurement is of great general value, by itself it is not conclusive, and must always be corrected by vertical measurements of the thigh and of the leg separately, and by enquiry into the history. It is necessary to remind the surgeon to be very careful to take the measurement from exactly the same point of the spine of the ilium on the two sides. Mistakes in this may easily be made in fat persons, and the best safeguard is for an assistant to mark the spot from which the measurement is to be taken with the forefinger of each hand; in this way it is easier to fix upon exactly the same point on each side.

2. **Determine the position of the great trochanter of the femur,** both as to its vertical and horizontal situation. This is to be done by the following methods :

(*a*) **Nelaton's line.**—Draw a line from the anterior superior iliac spine over the outer side of the hip to the prominence of the ischial tuberosity. The top of the great trochanter should just touch this line in every position of the joint. This line is of use to determine whether the trochanter is above or below its normal position. The length of the line in front of the trochanter gives roughly the horizontal position of the bone. It is a measurement easily taken; but possesses the drawback of requiring the patient to be rolled over towards the sound side, a movement which may be painful and injurious.

(*b*) **Bryant's line.**—With the patient lying flat on his back, draw a line vertically down to the bed from the anterior superior iliac spine, and then draw a second line from the top of the great trochanter up to join the first line at right angles; the length of the second line marks the vertical distance of the top of the great trochanter below the front of the iliac crest. This measurement, therefore, gives us the same information as Nelaton's line, but is greatly to be preferred to it, as it is obtained without any movement of the patient, and therefore without inflicting any pain or damage.

If a third line be drawn from the front of the iliac crest to the trochanter, it forms a triangle, and this third line gives roughly the horizontal position of the trochanter.

(*c*) The horizontal position of the trochanter may be measured by a tape passing from its tip to the middle line; but Mr. Henry Morris employs a more exact and trustworthy method. He places a straight rod on the pelvis, resting on the two anterior superior iliac spines, with the centre of the rod exactly over the middle line of the body. On each end of the rod he has a sliding vertical pointer, which is to be placed with its tip just resting on the outer side of the trochanter, the distance between the pointer and the centre of the rod, which is marked off in inches, can then be read off and at once compared on the two sides.

These measurements are of great value, as they are modified in all cases of dislocation of the hip joint, fracture of the acetabulum with displacement of the head of the femur into the pelvis, impacted fracture of the neck of the femur, many cases of unimpacted fracture of that part of the bone, and in cases of fracture and detachment of the great trochanter itself. Disease also modifies the position of the trochanter, for it may lead to dislocation of the bone or to shortening of the head and neck in morbus coxarius, or to shortening of the neck of the bone with depression of the head in chronic rheumatic arthritis; and it is here noteworthy that both these morbid states may be excited by injuries to the hip. It is doubtful if the great trochanter be ever depressed below its normal position, though it has been stated to occupy such a position in thyroid dislocation of the hip. With this doubtful exception, all injuries and diseases which affect its position in the vertical direction cause it to be raised, or, in other words, they make it pass above Nelaton's line, or shorten Bryant's line. A result of this displacement, which has been stated to be diagnostic of fracture of the neck of the femur, is lessened tension of the fascia lata of the outer side of the thigh, which can be detected by pressing the fingers horizontally inwards just above the great trochanter, or above the outer condyle of the femur. This relaxation of the ilio-tibial band of the fascia lata may be produced by any injury causing shortening of the thigh and approximation of its two attachments, and may be of use as a measure of this shortening, but must not be regarded as pathognomonic of fracture of the neck of the femur.

3. **The length of the thigh** is ascertained by taking *the distance* from the anterior superior spine of

the ilium to the upper border of the patella; or from the pubic spine to the adductor tubercle of the femur. Some prefer to take the lower border of the patella as the lowest point. If the patella be taken, great care must be used to ensure that the knee joint is in the same position in the two limbs, and the bone should be pushed up to its full extent. This measurement is affected by all those conditions modifying the vertical position of the trochanter, and, in addition, by fracture of the shaft of the femur with over-riding of the fragments, and by dislocation upwards of the patella, or, when the top of the patella is taken as the lower point, by transverse fracture of the patella, with separation of the fragments. The result may therefore be the same as that obtained by taking Nelaton's or Bryant's line; but when these lines show the head and neck of the femur to be uninjured and in their normal position, and yet the whole length of the thigh diminished, it indicates that the shaft of the femur is broken and shortened or the patella displaced.

4. **The length of the leg** is to be measured from the upper edge of either tibial condyle to the tip of the malleolus on the same side; these are the best points to take, but the lower edge of the patella or the tubercle of the tibia are also used as the upper points.

5. **The distance between the front of the head of the fibula and the tubercle of the tibia** will show whether the head of the fibula is occupying its right position on the outer tuberosity of the tibia.

6. **The relation of the malleoli to the tarsus** is a point of great importance in the diagnosis of many injuries of the foot. It may be ascertained by measuring in three directions:

(*a*) *From the tip of either malleolus to the point of the heel.*—If this measurement be shortened on each side of the foot it shows that the os calcis, with or without the astragalus, is displaced forwards upon the leg; similarly, if lengthened on each side it shows displacement of that bone backwards. A lateral displacement of the os calcis will increase the distance between the point of the heel and the malleolus from which it is removed, while the similar measurement on the side of the foot towards which the foot is displaced may be shortened or lengthened, but in the latter case will not be affected to the same extent as on the other side. These lateral displacements of the foot are so obvious that the surgeon is not likely to be led into any error by the fact that they modify the measurements in question, and so confound the lateral with the antero-posterior displacements of the foot, in the detection and correction of which these measurements are of great importance.

(*b*) *From the tip of the internal malleolus to the tubercle of scaphoid or point of great toe, and from the tip of the external malleolus to the tubercle of fifth metatarsal bone, or point of little toe.*—These measurements are lengthened when the foot is displaced forwards, and shortened when it is displaced backwards, and in all pure antero-posterior displacements of the foot correspond to the measurements from the malleoli to the heel. Where, however, the anterior measurements are different only in the two feet it shows that the injury is in the front part of the foot, and then it is of value to have taken the length not only to the point of the toe, but also to the scaphoid or fifth metatarsal bone, as it enables the surgeon to decide whether the deformity is in front of or behind these two bony points; displacement of a single bone, as *e.g.* the cuboid or the cuneiform, will affect the measurement on one side of the foot only.

(*c*) *From the tip of either malleolus to the sole.*—This is obtained by placing a book or flat board against the sole of the foot and then measuring the distance from it to each malleolus. This measurement may be shortened on the inner side by Dupuytren's fracture, and on both sides by dislocation of the astragalus, and may be lengthened by subastragaloid dislocation of the foot.

The seat and character of the pain the patient suffers, the functional disturbance in the limb, the resistance to passive motion at the various joints, and the history of the accident, with the age of the patient, are all of them points which may give important aid in diagnosis. In reference to the last two points, it may be mentioned that children are very liable to fracture of the shaft of the femur, which is frequently transverse in direction, as well as to separation of epiphyses and to greenstick fracture, which is, however, much rarer in the lower limb than the upper. Elderly women are predisposed to intracapsular fracture of the neck of the femur from slight indirect violence. Twists of the foot, as in slipping off the edge of the kerb, are the common cause of Pott's and Dupuytren's fractures. In missing a step, or in other attempts to prevent a fall, the patella may be broken; the neck of the femur is snapped by slight indirect violence, as in catching the foot against a mat, while from severe direct violence to the hip (falling on it, heavy blows upon it) impacted fracture of the neck is produced. Dislocations of the foot or of its individual bones are caused by falls from a height on to the foot, especially when the toes are pointed. The knee is dislocated by severe and sudden wrenches; and Mr. Morris has shown that the hip joint is only dislocated when in a position of abduction either by the limb being drawn away from its fellow, or, what comes to the same thing, by the trunk being forced over to the same side, and *that* the form of dislocation depends upon the amount of *flexion of the joint* and the direction in which rotation occurs. The severest fractures and injuries are those produced by direct crushing force.

By this examination the surgeon will have no difficulty in deciding what part of the skeleton of the limb, if any, is injured. We will now pass on to consider the diagnosis of the various injuries of the different regions, which we will group as follows :

A. Injuries about the hip joint.
B. Injuries of the thigh.
C. Injuries about the knee.
D. Injuries of the leg.
E. Injuries about the ankle.
F. Injuries of the foot.

A. **Injuries about the hip joint.**—When the history of the case, the seat of pain and possibly also of bruising and swelling, the loss of function, as well as obvious deformity and exact measurement, show that there is an injury to the bones of the hip, it is necessary to distinguish, as far as possible, between the numerous and important fractures and dislocations of this region. Deformity is the great symptom of all dislocations, and combined with it is marked fixedness of the joint; in fractures the deformity is, as a rule, less marked, and the simple helplessness of the patient, the loss of power, with pain, are the two most striking phenomena. The first grouping of these cases may be made according to the position of the limb, whether it is inverted or everted, and in any case in which the surgeon is in doubt as to which of these groups a case rightly belongs, the fact that the patient is unable to invert his limb may be taken as indicating that the limb is everted.

(1) **The limb is inverted,** or rotated in. The injuries that are attended with this deformity are :

Dislocation backwards.
Impacted fracture of the neck of the femur.

Press the fingers into the hollow of Scarpa's triangle and try to feel the head of the femur in its socket ; if, however, this space be found deeper than usual, and the fingers meet with no bony resistance just below the brim of the pelvis, there is a *dislocation;* while if the space be normal, and the same bony resistance is felt as on the uninjured side, the joint is not dislocated. If the joint be much flexed it clearly indicates a *dislocation*, while if quite extended, dislocation is excluded. Lastly, an attempt must be made to find the head of the femur in its new position on the buttock by firmly pressing the fingers into the mass of muscle of this region and at the same time gently rotating the limb inwards.

(*a*) If the limb be found inverted, flexed upon the pelvis, and adducted, shortened to the extent of one to two inches, the great trochanter being raised to this amount and anterior to its normal position, while the groin is found hollow and the rounded head of the femur is to be made out under the gluteal muscles on the buttock, it is a *dislocation on to the dorsum ilii.* There will be considerable rigidity of the part, and while passive flexion, adduction, and further rotation in will be possible, the attempt to extend, abduct, or rotate out the limb will cause great pain and meet with great resistance. If in manipulating the bone into its place crepitus be met with, and especially if the head of the bone at once or quickly slip out of its socket again, the case is one of *dislocation with fracture of the rim of the acetabulum.*

(*b*) If the limb be much inverted and flexed, adducted, slightly shortened, the trochanter being raised half an inch, or, at the most, an inch above its normal height, and the groin be hollow, the joint very rigid, flexion being the only movement possible, and the fingers fail to feel the head of the femur on the buttock, or feel it but indistinctly on the lower and back part of that region, there is a *dislocation on to the ischium,* or what is called "*into the sciatic notch.*"

The head of the bone is farther back, but lower down than in the former variety, and hence the actual shortening of the limb is less, although in some cases the apparent shortening may be greater, and the knee be found some inches above the sound knee; it is further noteworthy that the flexion of the joint becomes much more marked when the patient lies down than when he stands up. If the thigh be a little shortened and strongly inverted, and also adducted and behind its fellow, it indicates that the head of the bone is "strapped down by the great sciatic nerve."

(*c*) If the limb be greatly flexed, adducted, and inverted, the thigh even being in contact with the belly, the groin very hollow, and the head of the bone felt above the prominence of the ischial tuberosity, there is a *dislocation on to the tuber ischii.* This is a very rare form of the dislocation backwards; the trochanter may be found a little below or a little above its normal situation, according to the distance the head of the femur has passed back.

(*d*) If, in the absence of the signs of dislocation just enumerated, the limb be found extended and inverted, Bryant's line shortened from half an inch to an inch, the great trochanter approximated to the middle line, and there be pain and tenderness over the trochanter, while the joint can be moved passively in all directions, it is an *impacted fracture of the neck of the femur.* It is unusual for such a fracture to give rise to inversion of the limb, and the surgeon will therefore be careful to assure himself that the head of the bone is in its socket, by observing the usual fulness and resistance in the groin, its absence from the buttock, and the ability to obtain passive motion in all directions; but these movements must be made with all gentleness, lest the fracture be unimpacted; it is the directions and not the extent of the passive movements that are characteristic.

very prominent under the skin resting on the radius, it is a *dislocation forwards of the lower end of the radius.* These dislocations are both of them quite uncommon; they are sometimes spoken of as dislocations of the ulna in the opposite direction. In either case the length of the fore-arm, and the distance between the styloid processes and the bones of the metacarpus, are unaltered. Pronation and supination of the hand are very limited and painful.

(7) If a rounded projection be felt on the back of the carpus about its centre, firm and unyielding, and the movements of the wrist-joint are found to be free, a *dislocation backwards of the head of the os magnum* may be recognised. Occasionally the whole bone is displaced backwards, or one of the other bones, as the semilunar or pisiform bone, may be felt displaced. The position and the shape of the bony prominence will determine the diagnosis.

(8) If there be no obvious deformity, such as the above fractures and dislocations produce, the surgeon should seize the styloid process of the radius, and try to move it on the rest of the bone. If he find it movable, and the movement occasion crepitus, he will have no difficulty in diagnosing a *fracture of the styloid process of radius.* Similarly, mobility with crepitus are the signs of a *fracture of the styloid process of the ulna.*

(9) If free movement of the wrist-joint be painful and attended with crepitus, and yet neither of the styloid processes be movable, the injury is probably a *fracture of the carpus.*

(10) Pain in moving the wrist persisting for some days, and attended with marked tenderness along a vertical line over the end of the radius, and subsequently some slight thickening along this line, have been held to warrant the diagnosis of a *fissure of the lower end of the radius.*

H. **Fractures and dislocations of the metacarpus and phalanges.**—These bones are so subcutaneous that any irregularity in their contour is easily detected. The examination is to be made first by running the fingers along the bones of each digit to note irregularity, then by grasping the two extremities of each bone to attempt to obtain mobility in its length and crepitus, and lastly by pressing the end of each finger up towards the wrist, to observe whether it produces acute pain or crepitus. A convenient way of ascertaining whether there is any shortening is to place the two hands together palm to palm, when any shortening of a finger or the thumb is at once rendered obvious.

(1) *Dislocation of metacarpal bone of thumb* may occur backwards, or, more rarely, forwards. It is recognised by approximation of the base of the bone to the styloid process of the radius, and by the marked prominence the base of the bone forms on the dorsum or palm of the hand. It is distinguished from fracture with displacement by the position and shape of the prominence, and by the absence of crepitus. *Either of the other metacarpal bones may be partially dislocated backwards*, and form a prominence on the back of the hand; the bone can be pressed into place when the corresponding finger is extended.

(2) If a metacarpal bone is found to be deformed, and movement in its length is obtained, or crepitus, or the finger is found shortened, and pressure upon it up towards the wrist causes acute pain at one spot in the metacarpus, or is attended with crepitus, a *fracture of the metacarpus* may be diagnosed.

(3) Irregularity, mobility, or crepitus, or all these three signs together enable the surgeon to recognise easily *fracture of a phalanx*.

(4) Stiffness and pain at a phalangeal joint with shortening of the digit, and great increase of the

antero-posterior diameter of the joint, point to *dislocation of a phalanx.* The outline of the bones can be so plainly felt that there is no difficulty in deciding upon the direction of the displacement. All phalanges are most frequently dislocated backwards; those of the thumb may be dislocated forwards.

CHAPTER XIV.

THE DIAGNOSIS OF THE SPECIAL INJURIES OF THE LOWER LIMB.

A LARGE proportion of the fractures and dislocations of the lower limb are at once rendered apparent by the obvious deformity they occasion; in others the seat of pain marks the position of the injury, and the ready detection of crepitus enables the surgeon at once to diagnose a fracture; only in a small minority of cases is there grave difficulty in arriving at a conclusion as to whether a patient has sustained a fracture or a dislocation, and these are mainly met with in injuries of the hip-joint where the difficulty arises from the thickness of the soft parts overlying the articulation. In examining an injured limb, the surgeon should first of all expose the two limbs thoroughly, and look carefully to see if there be any deformity, an alteration in the axis or position of the limb or of any of its parts, an unusual prominence or depression or obvious alteration in its length, the existence of which will indicate both the fact of a lesion of the skeleton of the part, its situation, and in many cases its nature. Next, the limb should be examined by the hand, and here again it should be *compared* with the sound member. One hand should be placed on the outer side of each hip just below the crest of the ilium, and the top of the great trochanter of the femur felt for. In this way any marked alteration in the position and shape of this process will be detected. The fingers should be passed round behind it towards the buttock to explore that region, and to note any difference between the two sides, and particularly whether the head of the femur can be felt there. Next, the fingers should be gently pressed into the hollow of the groin, and any difference in the resistance encountered on the two sides, or any marked pain produced, noticed. The hands run down along the thighs will detect any great deformity in the shafts of the femurs, but in muscular persons these bones are so thickly covered that a slight alteration in the contour of the bone may readily escape notice. The marked local tenderness, which has been often before referred to in connection with fractures, will in this case, too, be of considerable value in this manipulation in arresting the surgeon's attention in cases where there is no obvious deformity. The bones of the knee, being more subcutaneous, can be more thoroughly examined. The joint should first be grasped laterally to determine whether there is any increase in its width, and then the hand may be passed down from the femur to the tibia, and the relative position of these two bones carefully compared on the two sides for the purpose of deciding whether the tibia is displaced forwards, backwards, or laterally upon the femur, or rotated upon its own axis. Then the patella should be felt for, and as this bone is wholly subcutaneous, its surface is easily felt and its position noticed. It may then be grasped above and below, and an attempt made to move one part independently of the other. Failing this, a similar attempt may be made upon the lateral halves of the bone. The head of the fibula resting against the outer tuberosity of the tibia should then be examined. And now the surgeon will pass his fingers down along the crest and subcutaneous inner surface of the tibia, and notice carefully any irregularity in the bone, or marked tenderness. By somewhat firmer pressure the outline of the fibula can be similarly explored. At the ankle joint the bones again become wholly subcutaneous, and the breadth of the malleoli and their outline can be easily compared on the two sides. The skeleton of the foot is readily felt from the dorsum, and any displacement of the bones either at the joints or elsewhere can be determined. The bony points to be specially felt for are the prominence of the heel, the tubercle of the scaphoid, and the projection of the base of the fifth metatarsal bone.

The examination of the general conformation and relations of the bones by the hand will add much to the knowledge obtained by the eye alone. Where such examination has led the surgeon to suspect the existence of a fracture, he will seek to determine this point at once by trying to obtain mobility or crepitus in the length of the bone. As in all other cases, so here, the utmost gentleness should be observed in making the necessary manipulations. The limb should be firmly grasped close above and below the suspected spot, and at first an attempt should be made to obtain movement or crepitus with quite slight force; this may be gradually increased when it is found that the bone resists, or at once discontinued as soon as any crepitus is felt. In some places the manipulation is a little different. At the upper part of the thigh it is impossible to grasp the limb in this way, and the plan adopted is for the surgeon to place his hand flat over the trochanter, and for an assistant to seize the foot and gently rotate the whole limb, the surgeon observing whether there is any crepitus, and *also* whether the trochanter moves with the shaft of the femur, simply rolls around its own axis, or moves in a circle as large as that on the sound side. This manipulation, too, must be carefully and gently executed, lest an impacted fracture should be unimpacted. At the knee, when the bone is broken, the parts of the patella may be separately taken hold of, and moved one upon the other, or either condyle of the femur may be movable in an antero-posterior direction upon the rest of the bone. At the ankle either malleolus may be moved in a similar manner. And I may here pause to point out that fractures of the malleoli are often overlooked from want of care in this manipulation, the injury being attributed to a sprain. Whenever there is marked local pain over either malleolus, and especially when to this is added acute tenderness to pressure at the same spot, the part of the bone below this spot should be seized, and a careful attempt made to move it upon the rest of the bone; failing that, the limb should be grasped with the thumb or fingers firmly pressed upon the painful spot, and with the other hand the foot should be flexed and extended and rocked laterally; by one or other of these manipulations crepitus will be obtained if there is a fracture.

The examination by the hand also gives other valuable information. Thus, in the thigh, it will determine the tension of the strong outer band of the fascia lata (ilio-tibial band). At the knee, the position, tension, or continuity of the ligamentum patellæ, and the state and position of the hamstring tendons will be noticed; while at the ankle the tendons behind each malleolus will be felt for, as these are liable to be displaced forwards. Having done this, or before attempting to elicit crepitus where fracture is not suspected, the surgeon will proceed to compare the two limbs by *measurement.* This is a most important part of the examination, and should never be omitted, unless the diagnosis is absolutely certain without it, as in transverse fracture of the patella, for example; and at the same time great care must be taken that the measurements are really between the same points on the two sides, or the surgeon may be seriously misled instead of being helped by his results. It is necessary also to place the two limbs in the same position when measuring them, and for this purpose the sound limb, which can be moved without occasioning pain, must be brought into the position assumed by the injured member. The best position for taking these measurements is the patient lying flat on his back, with the limbs extended straight and parallel, and the pelvis so placed that a line drawn from one anterior superior iliac spine to the other cuts a median vertical line at right angles. This latter line can be easily obtained by having one end of a piece of string held between the patient's central incisors and drawing the other end down so that the thread lies over the umbilicus and the symphisis pubis.

The following measurements will be found of use:

1. **The length of the limb from the anterior superior iliac spinous process to the tip of either malleolus.**—This gives the length of the entire limb, and alterations in it afford no guide as to the site of the deforming lesion, which may be in the hip, thigh, knee, or leg; it, of course, affords no information as regards the foot. When the measurement differs on the two sides, the surgeon must then proceed, by other sectional measurements of the limb, to determine where the deformity actually exists. It has of late years been shown as a normal occurrence that a good many people have the lower extremities unequal in length, *and generally* without any knowledge of the fact on

their part, and this inequality may amount to as much as an inch, or even more. But sectional measurements always show that this want of symmetry is not limited to any one section of the limb, but is shared by both the thigh and the leg. Therefore it is not enough to find simply that one lower extremity is longer or shorter than the sound one; it is necessary further to show that this inequality exists in one particular section of the limb. It must also be borne in mind that if one limb is an inch longer than the other, and it receives an injury (a fracture, for instance), it may be shortened by just so much, and the tape would then show the two limbs to be of the same length. This would be a circumstance of very exceptional character, but its mere possibility must arm the surgeon against being misled by it. It must also be remembered that previous injuries, diseases, or operations may have altered the length of a segment of the limb. In conclusion, then, although this measurement is of great general value, by itself it is not conclusive, and must always be corrected by vertical measurements of the thigh and of the leg separately, and by enquiry into the history. It is necessary to remind the surgeon to be very careful to take the measurement from exactly the same point of the spine of the ilium on the two sides. Mistakes in this may easily be made in fat persons, and the best safeguard is for an assistant to mark the spot from which the measurement is to be taken with the forefinger of each hand; in this way it is easier to fix upon exactly the same point on each side.

2. **Determine the position of the great trochanter of the femur,** both as to its vertical and horizontal situation. This is to be done by the following methods:

(*a*) **Nelaton's line.**—Draw a line from the anterior superior iliac spine over the outer side of the hip to the prominence of the ischial tuberosity. The top of the great trochanter should just touch this line in every position of the joint. This line is of use to determine whether the trochanter is above or below its normal position. The length of the line in front of the trochanter gives roughly the horizontal position of the bone. It is a measurement easily taken; but possesses the drawback of requiring the patient to be rolled over towards the sound side, a movement which may be painful and injurious.

(*b*) **Bryant's line.**—With the patient lying flat on his back, draw a line vertically down to the bed from the anterior superior iliac spine, and then draw a second line from the top of the great trochanter up to join the first line at right angles; the length of the second line marks the vertical distance of the top of the great trochanter below the front of the iliac crest. This measurement, therefore, gives us the same information as Nelaton's line, but is greatly to be preferred to it, as it is obtained without any movement of the patient, and therefore without inflicting any pain or damage.

If a third line be drawn from the front of the iliac crest to the trochanter, it forms a triangle, and this third line gives roughly the horizontal position of the trochanter.

(*c*) The horizontal position of the trochanter may be measured by a tape passing from its tip to the middle line; but Mr. Henry Morris employs a more exact and trustworthy method. He places a straight rod on the pelvis, resting on the two anterior superior iliac spines, with the centre of the rod exactly over the middle line of the body. On each end of the rod he has a sliding vertical pointer, which is to be placed with its tip just resting on the outer side of the trochanter, the distance between the pointer and the *centre of the rod*, which is marked off in inches, can then be read off and at once compared on the two sides.

These measurements are of great value, as they are modified in all cases of dislocation of the hip joint, fracture of the acetabulum with displacement of the head of the femur into the pelvis, impacted fracture of the neck of the femur, many cases of unimpacted fracture of that part of the bone, and in cases of fracture and detachment of the great trochanter itself. Disease also modifies the position of the trochanter, for it may lead to dislocation of the bone or to shortening of the head and neck in morbus coxarius, or to shortening of the neck of the bone with depression of the head in chronic rheumatic arthritis; and it is here noteworthy that both these morbid states may be excited by injuries to the hip. It is doubtful if the great trochanter be ever depressed below its normal position, though it has been stated to occupy such a position in thyroid dislocation of the hip. With this doubtful exception, all injuries and diseases which affect its position in the vertical direction cause it to be raised, or, in other words, they make it pass above Nelaton's line, or shorten Bryant's line. A result of this displacement, which has been stated to be diagnostic of fracture of the neck of the femur, is lessened tension of the fascia lata of the outer side of the thigh, which can be detected by pressing the fingers horizontally inwards just above the great trochanter, or above the outer condyle of the femur. This relaxation of the ilio-tibial band of the fascia lata may be produced by any injury causing shortening of the thigh and approximation of its two attachments, and may be of use as a measure of this shortening, but must not be regarded as pathognomonic of fracture of the neck of the femur.

3. **The length of the thigh** is ascertained by taking the distance from the anterior superior spine of

the ilium to the upper border of the patella; or from the pubic spine to the adductor tubercle of the femur. Some prefer to take the lower border of the patella as the lowest point. If the patella be taken, great care must be used to ensure that the knee joint is in the same position in the two limbs, and the bone should be pushed up to its full extent. This measurement is affected by all those conditions modifying the vertical position of the trochanter, and, in addition, by fracture of the shaft of the femur with over-riding of the fragments, and by dislocation upwards of the patella, or, when the top of the patella is taken as the lower point, by transverse fracture of the patella, with separation of the fragments. The result may therefore be the same as that obtained by taking Nelaton's or Bryant's line; but when these lines show the head and neck of the femur to be uninjured and in their normal position, and yet the whole length of the thigh diminished, it indicates that the shaft of the femur is broken and shortened or the patella displaced.

4. **The length of the leg** is to be measured from the upper edge of either tibial condyle to the tip of the malleolus on the same side; these are the best points to take, but the lower edge of the patella or the tubercle of the tibia are also used as the upper points.

5. **The distance between the front of the head of the fibula and the tubercle of the tibia** will show whether the head of the fibula is occupying its right position on the outer tuberosity of the tibia.

6. **The relation of the malleoli to the tarsus** is a point of great importance in the diagnosis of many injuries of the foot. It may be ascertained by measuring in three directions:

(*a*) *From the tip of either malleolus to the point of the heel.*—*If* this measurement be shortened on each side of the foot it shows that the os calcis, with or without the astragalus, is displaced forwards upon the leg; similarly, if lengthened on each side it shows displacement of that bone backwards. A lateral displacement of the os calcis will increase the distance between the point of the heel and the malleolus from which it is removed, while the similar measurement on the side of the foot towards which the foot is displaced may be shortened or lengthened, but in the latter case will not be affected to the same extent as on the other side. These lateral displacements of the foot are so obvious that the surgeon is not likely to be led into any error by the fact that they modify the measurements in question, and so confound the lateral with the antero-posterior displacements of the foot, in the detection and correction of which these measurements are of great importance.

(*b*) *From the tip of the internal malleolus to the tubercle of scaphoid or point of great toe, and from the tip of the external malleolus to the tubercle of fifth metatarsal bone, or point of little toe.*—These measurements are lengthened when the foot is displaced forwards, and shortened when it is displaced backwards, and in all pure antero-posterior displacements of the foot correspond to the measurements from the malleoli to the heel. Where, however, the anterior measurements are different only in the two feet it shows that the injury is in the front part of the foot, and then it is of value to have taken the length not only to the point of the toe, but also to the scaphoid or fifth metatarsal bone, as it enables the surgeon to decide whether the deformity is in front of or behind these two bony points; displacement of a single bone, as *e.g.* the cuboid or the cuneiform, will affect the measurement on one side of the foot only.

(*c*) *From the tip of either malleolus to the sole.*—This is obtained by placing a book or flat board against the sole of the foot and then measuring the distance from it to each malleolus. This measurement may be shortened on the inner side by Dupuytren's fracture, and on both sides by dislocation of the astragalus, and may be lengthened by subastragaloid dislocation of the foot.

The seat and character of the pain the patient suffers, the functional disturbance in the limb, the resistance to passive motion at the various joints, and the history of the accident, with the age of the patient, are all of them points which may give important aid in diagnosis. In reference to the last two points, it may be mentioned that children are very liable to fracture of the shaft of the femur, which is frequently transverse in direction, as well as to separation of epiphyses and to greenstick fracture, which is, however, much rarer in the lower limb than the upper. Elderly women are predisposed to intracapsular fracture of the neck of the femur from slight indirect violence. Twists of the foot, as in slipping off the edge of the kerb, are the common cause of Pott's and Dupuytren's fractures. In missing a step, or in other attempts to prevent a fall, the patella may be broken; the neck of the femur is snapped by slight indirect violence, as in catching the foot against a mat, while from severe direct violence to the hip (falling on it, heavy blows upon it) impacted fracture of the neck is produced. Dislocations of the foot or of its individual bones are caused by falls from a height on to the foot, especially when the toes are pointed. The knee is dislocated by severe and sudden wrenches; and Mr. Morris has shown that the hip joint is only dislocated when in a position of abduction either by the limb being drawn away from its fellow, or, what comes to the same thing, by the trunk being forced over to the same side, and that the form of dislocation depends upon the amount of *flexion of the* joint and the direction in which rotation occurs. The severest fractures and injuries are those produced by direct crushing force.

By this examination the surgeon will have no difficulty in deciding what part of the skeleton of the limb, if any, is injured. We will now pass on to consider the diagnosis of the various injuries of the different regions, which we will group as follows :

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B. Injuries of the thigh.
C. Injuries about the knee.
D. Injuries of the leg.
E. Injuries about the ankle.
F. Injuries of the foot.

A. **Injuries about the hip joint.**—When the history of the case, the seat of pain and possibly also of bruising and swelling, the loss of function, as well as obvious deformity and exact measurement, show that there is an injury to the bones of the hip, it is necessary to distinguish, as far as possible, between the numerous and important fractures and dislocations of this region. Deformity is the great symptom of all dislocations, and combined with it is marked fixedness of the joint ; in fractures the deformity is, as a rule, less marked, and the simple helplessness of the patient, the loss of power, with pain, are the two most striking phenomena. The first grouping of these cases may be made according to the position of the limb, whether it is inverted or everted, and in any case in which the surgeon is in doubt as to which of these groups a case rightly belongs, the fact that the patient is unable to invert his limb may be taken as indicating that the limb is everted.

(1) **The limb is inverted,** or rotated in. The injuries that are attended with this deformity are :

Dislocation backwards.
Impacted fracture of the neck of the femur.

Press the fingers into the hollow of Scarpa's triangle and try to feel the head of the femur in its socket ; if, however, this space be found deeper than usual, and the fingers meet with no bony resistance just below the brim of the pelvis, there is a *dislocation;* while if the space be normal, and the same bony resistance is felt as on the uninjured side, the joint is not dislocated. If the joint be much flexed it clearly indicates a *dislocation,* while if quite extended, dislocation is excluded. Lastly, an attempt must be made to find the head of the femur in its new position on the buttock by firmly pressing the fingers into the mass of muscle of this region and at the same time gently rotating the limb inwards.

(*a*) If the limb be found inverted, flexed upon the pelvis, and adducted, shortened to the extent of one to two inches, the great trochanter being raised to this amount and anterior to its normal position, while the groin is found hollow and the rounded head of the femur is to be made out under the gluteal muscles on the buttock, it is a *dislocation on to the dorsum ilii.* There will be considerable rigidity of the part, and while passive flexion, adduction, and further rotation in will be possible, the attempt to extend, abduct, or rotate out the limb will cause great pain and meet with great resistance. If in manipulating the bone into its place crepitus be met with, and especially if the head of the bone at once or quickly slip out of its socket again, the case is one of *dislocation with fracture of the rim of the acetabulum.*

(*b*) If the limb be much inverted and flexed, adducted, slightly shortened, the trochanter being raised half an inch, or, at the most, an inch above its normal height, and the groin be hollow, the joint very rigid, flexion being the only movement possible, and the fingers fail to feel the head of the femur on the buttock, or feel it but indistinctly on the lower and back part of that region, there is a *dislocation on to the ischium,* or what is called "*into the sciatic notch.*"

The head of the bone is farther back, but lower down than in the former variety, and hence the actual shortening of the limb is less, although in some cases the apparent shortening may be greater, and the knee be found some inches above the sound knee; it is further noteworthy that the flexion of the joint becomes much more marked when the patient lies down than when he stands up. If the thigh be a little shortened and strongly inverted, and also adducted and behind its fellow, it indicates that the head of the bone is "strapped down by the great sciatic nerve."

(*c*) If the limb be greatly flexed, adducted, and inverted, the thigh even being in contact with the belly, the groin very hollow, and the head of the bone felt above the prominence of the ischial tuberosity, there is a *dislocation on to the tuber ischii.* This is a very rare form of the dislocation backwards; the trochanter may be found a little below or a little above its normal situation, according to the distance the head of the femur has passed back.

(*d*) If, in the absence of the signs of dislocation just enumerated, the limb be found extended and inverted, Bryant's line shortened from half an inch to an inch, the great trochanter approximated to the middle line, and there be pain and tenderness over the trochanter, while the joint can be moved passively in all directions, it is an *impacted fracture of the neck of the femur.* It is unusual for such a fracture to give rise to inversion of the limb, and the surgeon will therefore be careful to assure himself that the head of the bone is in its socket, by observing the usual fulness and resistance in the groin, its absence from the buttock, and the ability to obtain passive motion in all directions; but these movements must be made with all gentleness, lest the fracture be unimpacted; it is the directions and not the extent of the passive movements that are characteristic.

(2) **The limb is everted,** or rotated out. The injury may be either of the following:

Contusion of the hip.
Dislocation of the hip.
Fracture of the neck of the femur.
Fracture of the acetabulum.

Place the patient flat on his back, and notice whether the injured limb is flexed or extended upon the pelvis; as a flexed hip may, by spinal lordosis, appear extended, bend up the opposite thigh to its full extent, until it lie against the belly and chest; if there be flexion of the injured hip, the thigh will be raised from the bed by this movement; if the joint be extended it will lie flat along the bed. In this way this large group of injuries may be subdivided.

The hip is flexed.—(*a*) If the prominence of hip be greatly flattened, the trochanter being considerably adducted towards the middle line and slightly raised towards the iliac crest, and the thigh abducted from its fellow, while the adductor muscles are found to be tense, and the rounded head of the femur is felt deep down under these muscles, it is a *dislocation of the head of the femur into the thyroid foramen.* If the patient be examined from behind, the fold of the buttock is found to be lowered on the injured side. The limb has been described as lengthened in this injury; but probably this is an error, arising from the tilting of the pelvis downwards to relax the psoas and iliacus muscles; should it occur, however, Bryant's line will, of course, be found lengthened, not shortened.

(*b*) If the thigh be strongly abducted from its fellow, and flexed, and the trochanter greatly adducted to the middle line, and the head of the femur be plainly felt in the perinæum much more superficial than in the previous case, it is a *dislocation of the head of the femur into the perinæum*; this is a much rarer variety of the injury, but the signs are very characteristic.

(*c*) If the great trochanter be raised by an inch or more from its normal position, and adducted, the hip being flexed, and the hollow of the groin lost, being filled out by the rounded head of the femur resting on the pelvis beneath Poupart's ligament, it is an *ilio-pubic dislocation* or *dislocation on to the pubes.* The femoral vessels should be felt for, and they will usually be found internal to the head of the bone.

(*d*) If the hip be greatly flattened, the trochanter being adducted, and Bryant's line considerably shortened (two inches), and the eversion of the limb be extreme, while the abduction and flexion are but slight, the head of the femur will be found resting on the pelvis below the outer part of Poupart's ligament close to the anterior inferior spine of the ilium; the injury is a *subspinous dislocation.*

(*e*) If the limb be shortened to the extent of two or three inches (the trochanter being raised to that extent) a little abducted as well as everted, and the head of the femur be plainly felt just below the anterior superior spine of the ilium, it is a *supraspinous dislocation.* The great trochanter is behind and outside the head of the bone, and is to be felt with difficulty, owing to the mass of muscle covering it.

(*f*) If the thigh be adducted, shortened, and everted, and the groin be hollow, and wanting in its normal resistance, and the head of the femur be felt on the dorsum of the ilium under the glutæi muscles, with the trochanter behind it, the injury is an *everted dorsal dislocation.* In this dislocation the limb may be extended. These last three are among the rarest forms of dislocation of the hip. It is useful to remember, as Bigelow has pointed out, that when the femur is unbroken, the direction of the internal condyle and of the head is always the same, and, therefore, in dislocations the direction of the head of the bone can with certainty be determined by noticing that of the internal condyle.

(*g*) If the limb be everted, shortened to a slight extent (half an inch or so), and the head of the femur be felt under the iliacus muscle below the anterior inferior spine of the ilium, and rotation of the thigh elicit crepitus, there is a *dislocation with fracture of the acetabulum.*

(3) **The limb is extended.**—(*a*) If the limb be extended, everted, powerless, but admitting of passive movement in all directions, shortened, the great trochanter being raised and adducted, and if gentle rotation elicit crepitus, and the trochanter which is not deformed be found to rotate around a very small circle, there is an *unimpacted fracture of the neck of the femur.* This accident is usually met with in old people, particularly in women, and as the result of indirect violence; there may be little or no bruising of the hip, or, what is still more characteristic, the bruising may only appear after some days, when the effused blood has had time to reach the surface. The limb is powerless, but admits of passive movement in all directions. The amount of shortening is generally slight (about half an inch, it may be more), and it is not uncommon for it to increase to an inch or more, either suddenly under manipulation, or gradually.

(*b*) If the limb be powerless, everted, extended, shortened, and the trochanter is adducted, and rolls around a circle only little smaller than the normal, and without crepitus, it is an *impacted fracture of the neck of the femur.* This injury results from direct injury to the hip, and is attended with greater bruising of the part. The shortening may be much greater than in the unimpacted variety, even two inches, or more; when the line of fracture implicates the trochanter or the extracapsular part of the neck of the bone, the surgeon may be able to detect some deformity about the bone. Great care must be taken in these manipulations not to unimpact the fracture.

(*c*) If there be eversion of the limb, loss of power, bruising, pain, and tenderness over the great trochanter, which may be found raised and drawn back, while the length of the thigh is unaltered, and on seizing the trochanter it is found to be movable, with or without crepitus, there is a *fracture of the great trochanter;* if these signs are found in a child under sixteen years of age, they indicate a *diastasis of the great trochanter.* This injury is very rare.

(*d*) If there be eversion of the limb, with shortening, and the tip of the trochanter is found raised, and perhaps displaced backwards as well, while rotation of the limb occasions crepitus, but the tip of the trochanter is found not to move with the shaft of the femur, the accident may be diagnosed to be a *fracture through the neck and great trochanter of the femur.* The patient will be unable to sit, and any attempt to rise or to flex the hip will cause great pain. It is a very rare injury.

(*e*) If after a fall upon the hip the patient be unable to stand, and complain of great pain in the joint, but the various measurements of the limb are unaltered, and movement do not occasion crepitus, but pressure upon the pubic spine elicit sharp pain, the signs were said by B. Travers to indicate a *fissure of the acetabulum;* but this diagnosis is always open to grave doubt.

(*f*) If, however, after a direct injury to the hip, the limb be found of its normal length, the trochanter neither raised nor lowered, abducted nor adducted, and the trochanter is found to rotate normally, and yet on moving the hip joint pain and crepitus are produced, a *fracture of the acetabulum* may be diagnosed. When the head of the bone is displaced towards the pelvis, being forced through the acetabulum, the diagnosis becomes more difficult, as the limb is shortened, the trochanter adducted and raised, there may be either eversion or inversion, and fracture or dislocation may be simulated. Failure to find the displaced head of the bone would eliminate dislocation. Examination of the interior of the pelvis *per rectum* and *per vaginam*, as well as the pain elicited by pressure upon the pubes and ilium, would probably enable the surgeon to distinguish this injury from a fracture of the neck of the femur. (*See* page 165.)

(*g*) If after a direct injury to the hip the limb be found everted, and (possibly) bruised, and the patient complain of pain in it, and is unable to move it, but the surgeon finds no alteration in its length, no displacement of the trochanter, no limitation of movement, no crepitus, no want of proper resistance in the groin, no obliteration of the depression behind the trochanter, he may diagnose a *contusion of the hip.* This injury may be followed by slow gradual shortening of the limb and raising of the trochanter from absorption of the neck of the bone. The great pain, the loss of power, and the eversion of the limb make this injury simulate a fracture, and the subsequent shortening makes the resemblance still closer. When the patient is already the subject of *rheumatoid arthritis,* which has led to shortening of the limb and some deformity of the trochanter, it is impossible to diagnose a contusion of the soft parts from an impacted fracture of the neck of the bone, unless the surgeon is aware of the previous condition of the joint.

B. **Injuries of the thigh.**—The diagnosis of a fracture of the femur is usually to be easily made from the obvious deformity, marked shortening, loss of *power in the limb*, mobility in the length of the bone, and crepitus. But several of these signs may be absent. Where, then, as the result of an accident, or, rarely, of sudden muscular effort, a patient complain of pain in the thigh, and inability to stand upon it, or to move it at all, inspect the limb, and if there be eversion of the foot and knee, with obvious angular deformity of the thigh below the great trochanter, with shortening of the thigh (the position of the trochanter being normal), there is a *fracture of the femur.* The deformity is usually a curve of the bone outwards and forwards. To detect the abnormal mobility and crepitus, it may be sufficient to place the hand beneath the deformed part of the thigh, and to raise it gently, or the limb may be extended, and gently rotated, when the surgeon will notice crepitus, a lessening of the deformity and of the shortening, and want of rotation of the trochanter with the foot. Where there is this angular deformity of the thigh, if crepitus be obtained without extension of the limb, it shows that the fracture is oblique, with overriding of the fragments. When, however, crepitus is only obtained after extension and correction of the deformity, it shows that the fracture is transverse, with complete displacement of the fragments.

Where, however, on examining the limb there is found eversion of the knee and foot, but no shortening and no obvious deformity, the surgeon should pass his fingers down along the thigh, pressing in upon the bone until he comes upon a very tender spot, where he will probably find some swelling; while he grasps the thigh above this spot, his assistant should gently rotate the leg and knee, and if the surgeon feel crepitus, or notice that the upper part of the thigh does not move with the knee, he diagnoses a *fracture of the femur without displacement* of the fragments. This injury is most common in children; in such cases the periosteum is usually incompletely ruptured. In children the surgeon can make the necessary manipulation himself without any aid.

Where in a young child, after a fall, the thigh is found bent forwards and shortened, and the child does not use it or move it, and the bent part is tender and swelled, but there is no crepitus, while the upper end of the bone moves with the lower end, there is an *incomplete fracture of the femur.*

The surgeon should remember that it is common to find the signs of effusion into the knee joint a few days after fracture of the femur, especially when the injury is in the lower third of the bone, and is the result of direct violence.

C. **Injuries about the knee.**—The special injuries that may be met with in this region are:

Fracture of the lower end of the femur, of the upper end of the tibia, and of the patella.
Dislocation of the tibia, of the fibula, of the patella, or of a semilunar cartilage.
Sprain, rupture of lateral ligaments, or of ligamentum patellæ.

As the bones are so superficial, and their fracture and dislocation are attended with marked deformity, there is usually not much difficulty in distinguishing these various injuries. In cases where there is an alteration in the plane or in the axis of the limb about the knee joint, the surgeon must determine whether the displacement is at or near the articulation. For this purpose the head of the tibia must be carefully felt to ascertain whether the displacement is between the femur and tibia, or at a higher or a lower level. Being satisfied on this point, the surgeon should grasp each condyle of the femur and each tuberosity of the tibia separately, and attempt to move it on the rest of the bone; the same may be done with the head of the fibula on the outer side of the tibia. The patella may *then be examined,* its outline defined, and compared with that on the other side; an attempt may also be made to obtain movement transversely and longitudinally; while failing that, firm pressure should be made all around its edge, and across its surface, any crepitus elicited being carefully noticed. The relations of the patella to the femoral condyles should be compared on the two sides, and the continuity of the patellar ligament traced from the patella to the tubercle of the tibia. Until the surgeon has satisfied himself that the patella and its ligament are entire he should not bend the knee joint, as fracture of the bone and rupture of the ligament may be seriously exaggerated in their effects by such a movement. Having in this way examined the bones and the patellar ligament, the surgeon should examine closely the interval between the tibia and the femur, to notice any difference between the two limbs, and then, grasping the leg, he should test the amount of lateral motion in the joint; of course he will observe the outline of any swelling of the soft parts.

The leg is displaced laterally.—This may be due either to dislocation of the tibia, or to separation of the lower epiphysis of the femur.

(1) If the femoral condyles be found continuous with the shaft of the bone, and immovable upon it, and the head of the tibia project to either side of the femur, the patella lying on the corresponding condyle instead of between the two, and the joint being nearly if not quite immovable, the injury is a *lateral dislocation of the tibia.* This form of dislocation is incomplete; it may occur to either side, and when the tibia is displaced outwards it is usually also rotated out, the foot being everted. Correction of the deformity is not attended with crepitus.

(2) If, however, both the femoral condyles be found resting upon the head of the tibia in their normal relation, but the lower end of the femur

be displaced to either side, movable, with soft crepitus, and if there be some amount of flexion and extension movement in the joint, there is a *separation of the lower epiphysis of the femur with lateral displacement.* This accident may occur at any time up to sixteen years of age.

The leg is displaced antero-posteriorly.

(*a*) If the femoral condyles with the patella lying between them project at the front of the knee, and the leg is lying at a posterior level, projecting backwards into the ham, the whole limb being shortened, and the measurement from the adductor tubercle to the tip of the internal malleolus is also shortened, there is a *dislocation of the tibia backwards.*

(*b*) If, however, the anterior projection be found above the condyles of the femur, higher up than or tilting forward the patella, and the condyles of the femur are situated immediately above and in contact with the head of the tibia, but a firm mass or bony projection is felt in the ham, and the measurement from the adductor tubercle to the internal malleolus is not shortened, although that from the iliac crest to the malleolus is shortened; and, further, if movement of the part elicit crepitus, there is a *supracondyloid fracture of the femur.* If the patient be under seventeen years of age, and the crepitus soft, it is a *diastasis.* In this injury the sharp lower end of the upper fragment may transfix the triceps muscle, or even the skin. If with these signs either condyle be found movable apart from the other, it would show that the injury was an *intercondyloid fracture ;* there would then certainly be effusion of blood into the knee joint, distending the synovial cavity.

(*c*) If the anterior prominence be formed by the head of the tibia, and the back of the femoral condyles be felt projecting strongly in the ham, the joint being *rigid, the entire* limb, and the leg as measured from the lower end of the femur, being shortened, and there being no crepitus, the injury is a *dislocation of the tibia forwards.* In these injuries the circulation in the popliteal vessels is very apt to be interfered with, and therefore in every case the surgeon must carefully observe the pulse in the tibial arteries, the state of the superficial veins, and whether a swelling rapidly forms in the ham.

The leg is not displaced.—The surgeon must first assure himself of the condition of the bones, and he should examine them in the following order: patella, femur, tibia, fibula.

(*a*) The patella should be found lying flat upon the femur between the two condyles, with its ligament passing straight down from it to the tubercle of the tibia, and when the knee joint is extended, and the quadriceps is relaxed, the bone can be moved laterally. It may be found lying on the side of either condyle of the femur, more frequently the outer, with its anterior surface directed outwards or inwards, and its articular surface resting on the femur, fixed in position, and having its ligament passing obliquely down to its insertion, and leaving the trochlea of the femur empty, and easily felt through the skin; in such a case the surgeon has no difficulty in diagnosing a *lateral dislocation of the patella.*

(*b*) The patella may be seen and felt very prominent in front of the knee, with one edge directed forwards and the other edge resting on the trochlea of the femur; what should be the anterior surface of the bone, that continuous with the front of the patella ligament, will be found directed outwards, while the articular surface will be directed inwards. This is a *dislocation of the patella on to its outer edge.*

(*c*) If, on feeling for the patella, the trochlea of the femur be felt, and the bone be found higher up the thigh, movable both laterally and vertically, and if below the bone a gap in the firm patellar ligament be felt, the case is one of *rupture of the ligamentum patellæ with dislocation of the patella upwards.*

(*d*) If the bone be felt occupying too low a position, and its ligament be relaxed, while above the bone a depression in the quadriceps muscle be felt, there is a *rupture of the extensor muscle with dislocation of the patella downwards.* If some time have elapsed since the accident, there may be a swelling over the rupture in the muscle, preventing the surgeon feeling the gap in it. In either of the latter two cases the patient will have lost the power of extending the knee joint. The displacement of the patella can be verified by measurements between it and the iliac crest and the tibial tubercle.

(*e*) If on examining the bone a gap be seen or felt across it, a part of the bone being attached to the extensor muscle and a part to the patellar ligament, with mobility between the two parts; or if, without any such gap, on seizing the upper and lower parts of the patella in the two hands, one can be moved on the other with crepitus, there is a *transverse fracture of the patella.* The amount of separation between the fragments varies from nil to two inches or more; it should never be increased or made apparent by flexing the knee if the injury is recent, as this may lacerate the fibrous structures on the side of the bone, which are of great importance in preventing the displacement of the upper fragment. The amount of separation of the fragments is a measure of the laceration of the fibrous tissue over and on the sides of the bone. Quickly after the accident the joint will be swelled from effusion of blood into it. The patient will have lost the power of extending the knee.

(*f*) If on grasping the bone laterally a portion of it be found to move on the rest with crepitus, or if, on pressing over the front of the bone, an irregularity of the bone be felt, and crepitus be elicited, or on pressing on the edge of the bone in some one spot crepitus be detected, a *vertical or oblique fracture of the patella* has occurred. In these cases, too, the joint becomes distended with blood, but the loss of power is not so great as in the former case, nor is there the obvious deformity sometimes met with in transverse fracture of the bone. When the surgeon has satisfied himself that there is no fracture of the patella, he may in his subsequent manipulations bend the knee joint.

Grasp each condyle of the femur separately, and try to move it from before back, or obliquely up and down on the shaft of the bone, and run the fingers over the bone to detect any projecting angle. Repeat this manipulation on the tuberosities of the tibia; notice any increase in width of the head of the tibia, and measure it with compasses, measuring also the length of the leg from the patella to either malleolus. Then feel for the head of the fibula, and, comparing it with the one on the uninjured side, notice if it be displaced forwards or backwards, be more movable than normal, or whether the tendon of the biceps attached to it is lost under the ilio-tibial band of fascia lata, or is too prominent at the back of the joint.

(*g*) If either condyle be movable on the rest of the bone, or the attempt to obtain movement elicit crepitus, there is a *fracture of a condyle of the femur*. The direction of the mobility as well as the detection of a projecting ridge or angle of the bone will enable the surgeon to determine the position and direction of the fracture, which may be transverse or oblique. The symptoms of the injury will be pain, bruising over the knee, loss of power to move the joint, and effusion into it.

(*h*) If either tuberosity of the tibia be movable with crepitus, or the head of the bone be increased in width with slight shortening of the leg, and the part be painful, tender and swelled, a *fracture of the head of the tibia* is to be diagnosed. This is a rare and a severe accident. The upper epiphysis of the bone may separate in a child or adolescent. If there be much shortening of the leg from impaction of the shaft in the head, there will be found either a fracture or a dislocation upwards of the fibula. This injury is quickly followed by effusion into the knee joint.

(*i*) If the head of the fibula be found in front of its normal position, and the usual prominence of the biceps tendon be lost beneath the ilio-tibial band or fascia, there is a *dislocation of the head of the fibula forwards.* The signs may be reversed, and the head of the bone be found projecting at the back of the knee with the outer hamstring abnormally prominent in the ham; then a *dislocation of the head of the fibula backwards* is to be diagnosed.

When the surgeon has in this way examined all the bones of this region, and found them unbroken and not displaced, he must proceed to investigate the softer parts, and he must be especially careful to assure himself that there is no displacement of a semilunar cartilage or rupture of either lateral ligament of the joint, in cases which might be assumed to be simple sprains. To do this he should feel carefully on each side of the patellar ligament for any projection as of a displaced cartilage, also over the line of the joint between the femur and the tibia; and he should then estimate the amount of lateral movement possible in the joint.

(*j*) If, after some jerk, strain, or sudden movement of the joint, the patient complain of a sudden severe pain in the joint, and if he be unable to extend it or bend it completely, although passive movement *short of* extreme limits is free, and does not occasion much pain, there is probably a *dislocation of a semilunar cartilage.*

If, now, there be a swelling felt on either side of the joint just over the line between the femur and tibia, corresponding to the cartilage in outline and feel, especially if there be a clear history of this swelling having appeared at the time of the accident, and if on manipulation it can be pressed into place with relief of pain and of the stiffness of the joint, this diagnosis is certain, and the displacement is to be described as *marginal* or *extra-articular.* If, however, there be no such swelling, but an interval be felt between the femur and tibia, and especially if to this be added the detection of a projection on the same side of the patellar ligament, and slight relaxation of the ligament, the diagnosis is confirmed, and the displacement is to be described as *central* or *intra-articular.* This injury is liable to be mistaken for the impaction of a loose body in the joint and *vice versâ.* But attention to the following points will enable a diagnosis to be made. A semilunar cartilage is always *first* displaced by some sudden wrench of the joint, although subsequently it may slip out of place during any sudden or extreme movement of the joint. The impaction of a loose body between the articular surfaces is not dependent upon a wrench or sudden twist of the joint, but occurs during the customary movements. When dislocated, the semilunar cartilage may be felt projecting; the loose body, on the other hand, cannot be felt when impacted, but may be felt between the attacks of pain freely floating in the synovial cavity. In impaction of a loose body the joint is locked; in dislocation of a semilunar cartilage, the joint is capable of free passive motion. A cartilage may remain dislocated and cause lameness for a long period, or even permanently; the impaction of a loose body between the bones is always an acute affection, and is corrected by some sudden active or passive movement; it may often recur, but is not a chronic or permanent condition.

(*k*) If, after a sudden wrench of the knee, there be found increased lateral movement of the tibia to one side, the surgeon may diagnose *rupture of the lateral ligament* on the opposite side of the joint; this diagnosis will be confirmed by finding the pain chiefly situated on that side, or by swelling and ecchymosis.

(*l*) If, after a wrench or strain of the joint, there be great pain, inability to move the joint, swelling assuming the form of the synovial cavity, and passive movement be found free but painful, and there be an absence of the signs of any of the injuries above mentioned, the case is to be diagnosed as a *sprain of the knee.*

D. **Injuries of the leg.**—The tibia for its whole length, and the fibula for some distance, are so subcutaneous that any deformity of the shafts of these bones is readily recognised, either by the eye or by the hand. Deformity is not marked unless both bones be fractured, but it may be so striking as to render the diagnosis certain. Where that is not the case, the surgeon should run his fingers carefully down the inner surface of the tibia, comparing the two bones, noticing any little unevenness, the position of chief pain, and particularly of marked tenderness; then grasping the leg above and below the most tender or painful part, he should attempt to obtain mobility and crepitus. A similar examination of the fibula should be made, and in addition it should be pressed in towards the tibia just below its head and above its malleolus, to observe whether this gives crepitus, or causes acute pain at a distance from the point compressed. The *deformity, or the* direction of mobility, will usually at once make it clear in what direction the bones are broken.

(1) If there be marked deformity of the leg, with pain, swelling, loss of function, shortening of the distance between the tubercle of the tibia, and either malleolus, free mobility in the length of the leg, and crepitus, these signs clearly indicate a *fracture of the shafts of the tibia and fibula.* The most frequent deformity is the projection forwards of the lower end of the upper fragment of the tibia, with eversion of the foot and the lower part of the leg. Where this deformity exists a very careful examination of the ankle joint should be made, with a view of determining whether the lower fragment is fissured into the joint (the V*-shaped fracture* of Gosselin), in which case both the surgeon and the patient should be prepared for more or less ankylosis of the ankle. When it is certain the tibia is fractured, there is no justification for a prolonged or painful examination into the state of the fibula; that bone is certainly broken when the injury is the result of indirect violence, or when there is marked shortening, deformity, and ready mobility. When the surgeon is in doubt upon the point, the bone should be assumed to be broken; the fact will not alter the treatment, and the attempt to discover the full truth may seriously increase the laceration of the soft parts.

(2) Where there is no obvious deformity of the leg, with no shortening of the limb, and yet there are marked pain and tenderness over one part of the tibia, with swelling, and loss of power in the limb, and on manipulation crepitus is elicited, slight mobility being detected, but the line of the fibula unbroken, and this bone is not the seat of severe pain or tenderness, the surgeon should diagnose a *fracture of the shaft of the tibia.*

(3) If there be a severe fixed pain at a particular

spot on the outer side of the leg, increased by standing or attempting to walk, the surgeon should examine the fibula carefully. If he find that the painful part is very tender, and that when the fibula is compressed against the tibia by grasping the leg just below the knee or above the ankle, smart pain is caused at the same tender spot (not at the point pressed upon) the diagnosis of *fracture of the shaft of the fibula* may be made. This diagnosis will, of course, be confirmed if the finger detect any irregularity in the outline of the bone, or any crepitus on compressing the two bones, or if the surgeon notice a failure of the natural rebound of the fibula after its compression against the tibia.

(4) If there be no evidence of a complete fracture of the tibia, such as we have just mentioned, but the patient complain of a severe and fixed pain in the bone, and on careful examination the part where the tenderness is greatest is found not to be a spot, but a line running obliquely across or vertically down the bone, and if along this same line of tenderness a linear induration or swelling on the bone be subsequently detected, the surgeon may diagnose a *fissure of the tibia.* This injury is often very difficult to diagnose, and to distinguish from a bruise of the part.

(5) If, during some sudden exertion, the patient experience a severe pain in the calf, or behind the ankle, and lose power in his leg, and on examination the bones and joints are found uninjured, but above the heel there be ecchymosis and swelling, and a depression be felt where the prominent tendo Achillis should be, the surgeon will have no difficulty in diagnosing a *rupture of the tendo Achillis.* When with these symptoms this tendon is found entire, but all voluntary attempts to extend the ankle give great pain, while passive movement of the joint is free, and *especially if the* patient felt or heard any "snap" at

the time of the accident, a *rupture of the plantaris tendon* is to be recognised. Rupture of the tendo Achillis may be attended with a loud snap.

E. **Injuries about the ankle.**—Under this head are included a large group of injuries: fractures of the lower ends of the bones of the leg and of the astragalus; dislocations of the fibula, the ankle, the astragalus, and of the foot from the astragalus, together with displacement of the peronei or posterior tibial tendons and sprains of the ankle joint. The difficulty of diagnosis is increased by reason of the fact that a characteristic deformity (as of Pott's fracture) may be corrected before the surgeon sees the case, and by the great swelling which quickly ensues upon many of these injuries. The nature of the accident, the character and seat of the pain, and the degree to which the function of the part is lost, are facts valuable as suggestive of the nature of the injury. The cases group themselves naturally into those in which there is no obvious deformity, and those in which there is a striking deformity.

(1) **There is no obvious deformity of the ankle.**—Careful measurement should be taken of the length of the leg, and of the distance between the malleoli and the heel, and between the malleoli and the tubercles of the scaphoid, and of the fifth metatarsal bones respectively to show that there is no bony displacement, as a slight slipping of the part laterally or antero-posteriorly might otherwise escape detection. The seat of pain and tenderness should be carefully observed, and then each malleolus should be grasped, and an attempt made to move it independently. The part should then be seized and moved laterally, and be pressed up into the arch of the tibia, and moved freely.

(*a*) If in this examination either malleolus be found movable with crepitus, it will demonstrate the presence of a *fracture of a malleolus;* the line of fracture may separate the whole of the lower end of the tibia.

(*b*) If, with signs of fracture of the lower end of the fibula, there be found increased lateral mobility in the ankle joint, it shows that the internal malleolus or the internal lateral ligament has been broken, and that the injury is a *Pott's fracture,* with reduction of the displacement.

(*c*) If there be no evidence of fracture of the bones of the leg, but the attempt to stand causes great pain, and movement of the foot causes crepitus deep in under the arch of the ankle, the surgeon may diagnose *fracture of the astragalus.*

(*d*) If there be acute pain over or behind either malleolus, with swelling and ecchymosis, feel carefully for the tendons which should be behind the bones, and if there be an unnatural depression behind, or an elongated prominence over either malleolus, or if, when the patient extends the foot, the tendon can be felt to slip forward on to the bone, with severe pain, the diagnosis of *dislocation of peroneus longus or tibialis posticus tendon* should be made. There may be some unnatural mobility of the foot in this injury.

(2) **There is obvious deformity about the ankle.** (*a*) **The foot is displaced outwards.**—This may be due to

(α) Pott's fracture;
(β) Dupuytren's fracture,
(γ) Subastragaloid dislocation of the foot.

(α) If the foot be displaced out, if its outer border be raised, with the sole looking down and out, and the inner ankle be very prominent, while there is a marked depression on the outer side of the leg above the ankle joint, the injury is a *Pott's fracture,* with *persistence of the* original displacement. The shape of the inner malleolus, or the detection of a small movable fragment of bone below it, may show that this process of bone is broken; where this bone does not give way the internal lateral ligament is torn. When the deformity is reduced there may be found increased lateral mobility in the ankle.

(β) If the foot be displaced outwards to a considerable extent, and not at all, or only to a slight degree, everted, the inner ankle being very prominent, and nearer the sole than normal, while the breadth between the two malleoli is greatly increased, and the length of the leg, measured to the tip of the outer malleolus, is shortened, the injury is a *Dupuytren's fracture.* There is a depression over the fracture of the fibula, above the malleolus, as in the former case.

(γ) If there be no increased lateral movement in the ankle, no depression over the lower part of the fibula, but both it and the tibia be entire, and the length of the leg as measured to the tip of either of them be unaltered; and with this there be great prominence of bone in front of and below the inner ankle, while the foot is displaced out and everted, and the outer ankle is sunk in a depression, the injury is a *subastragaloid dislocation of the foot outwards.* This is usually combined with backward displacement of the foot, undue pointing of the heel, and shortening of the part in front of the ankle.

(*b*) **The foot is displaced inwards.**—This may be due to

(α) Dislocation of the ankle inwards;
(β) Subastragaloid dislocation of the foot inwards;
(γ) Dislocation inwards at the medio-tarsal joint.

(α) If the lower end of the fibula be very prominent on the outer side, and the astragalus and internal malleolus project on the inner side of the ankle, while the width between the malleoli is increased with the ankle joint allowing of lateral movement, the injury is a *dislocation inwards of the ankle.* This is a very rare accident, and is always accompanied with fracture of one or both of the bones of the leg.

(β) If the foot be displaced inwards and the inner malleolus be sunk in a hollow caused by the inward projection of the foot, and on the outer side of the dorsum is a rounded prominence of the head of the astragalus in front of the outer malleolus, there is a *subastragaloid dislocation of the foot inwards.* This is generally combined with some amount of backward displacement of the foot, increasing the distance between the malleoli and the heel, and lessening the distance between the inner malleolus and the scaphoid, or the outer malleolus and the base of the fifth metatarsal bone.

(γ) If the relation of the malleoli to the heel be unaltered, but the anterior part of the foot be displaced inwards, the tubercle of the scaphoid bone being very prominent on the inner side of the foot, while the front of the os calcis projects on the outer side in front of the outer malleolus, and the cuboid and fifth metatarsal bone are displaced inwards, the surgeon will recognise a *dislocation inwards at the medio-tarsal joint.*

(c) **The heel is flattened,** *i.e.* has lost its natural prominence. This may be due to

(α) Dislocation of the foot forwards,
(β) Subastragaloid dislocation forwards;
(γ) Transverse fracture or the os calcis.

(α) If the projection of the heel be lessened or lost, and the length of the foot in front of the tibia and fibula, as measured from either malleolus to the extremity of the toe of the same side, or to the tubercle of the scaphoid or to the base of the fifth metatarsal *bone be increased*, there is a *dislocation of the foot* *forwards.* The dislocation may be partial or complete; when complete the malleoli are approximated to the sole, the tibia projects behind, and the upper surface of the astragalus can be felt in front of it. This is a very rare injury.

(β) If the projection of the heel be lost, and the length of the foot in front of the leg be increased, but the malleoli not approximated to the sole, the ankle still allowing some amount of passive movement, while in front of the lower end of the tibia the rounded head of the astragalus can be felt, and in front of that a depression, the surgeon may diagnose a *subastragaloid dislocation of the foot forwards.* This is an exceedingly rare accident.

(γ) If the heel be flattened, but the length of the foot in front of the malleoli is not increased, feel carefully along the tendo Achillis, and if at its extremity, which is above the heel, the portion of bone to which it is attached be felt movable, there is a *fracture of the os calcis.* There may be great, little, or no separation of the fragments, depending upon the extent to which the fibrous structures are torn.

(*d*) **The heel is elongated,** *i.e.* its prominence is increased; this may be due to

(α) Fracture or diastasis of lower end of tibia,
(β) Dislocation of the ankle backwards;
(γ) Subastragaloid dislocation of the foot backwards.

(α) If the heel project behind, and its relations to the two malleoli are unaltered, whilst above the ankle-joint there is a projection forwards of the tibia, and by drawing the foot forwards the deformity is corrected, and crepitus is elicited, there is a *fracture of the lower end of the tibia and fibula.* If the accident occur in an individual under eighteen years of age, and the anterior projection be rounded, and the crepitus not easily obtained, and soft in character, it is to be recognised as a *diastasis of the lower epiphysis of the tibia.*

(β) If the heel be lengthened, and the front of the foot shortened, as measured from the malleoli, while the malleoli are approximated to the sole, all movements at the ankle joint being abolished, and if the lower ends of the tibia and fibula can be felt resting upon the scaphoid and cuboid bones, while the astragalus, if felt at all, is felt behind the tibia, between it and the tendo Achillis, the injury is a *dislocation of the foot backwards.*

(γ) If the heel be lengthened, and the front of the foot shortened, but the tibia and fibula are not resting on the scaphoid and cuboid, but are separated from those bones by the rounded and prominent head of the astragalus, which projects on the dorsum of the foot, in front of the tibia, the injury is a *subastragaloid dislocation of the foot backwards.* There may be some amount of passive flexion and extension still possible at the ankle joint.

(*e*) **The heel is raised.**—This deformity may be caused by

(α) Dislocation of the foot upwards;
(β) Fracture of posterior part of tibia and fibula;
(γ) Fracture of os calcis.

(α) If the malleoli are widely separated, with the skin tightly stretched over them, and their extremities approximated to, or actually reaching, the sole, while the length of the tibia is unaltered, and that of the leg, measured to the sole, is decreased, the injury is a *dislocation of the foot upwards* between the tibia and the fibula.

(β) If the heel be raised, the toes pointed down, and the breadth of the outer malleolus increased, while a vertical depression or groove along it shows that it is *split into an* anterior part continuous with the shaft of the bone, and a posterior one adherent to the displaced foot; and, further, if there be a depression immediately in front of the lower end of the tibia, with crepitus on attempting to reduce the deformity, the surgeon is to recognise a *fracture of the posterior part of the lower end of the tibia and of the fibula*, with displacement of the foot and of the separated fragment up and back.

(γ) If the prominence of the heel be raised, and be movable apart from the rest of the foot, the surgeon will, of course, recognise a *fracture of the os calcis*, which in a young person under sixteen years of age may be a *separation of the epiphysis* of the bone. This injury is also referred to on page 233.

(*f*) **The heel is displaced outwards.**—This is a very rare deformity; but if the heel, without the anterior part of the foot, be displaced outwards, and be very prominent under the skin, and the arch of the foot be flattened, the injury is a *dislocation outwards of the os calcis*. Passive flexion and extension of the ankle joint is possible, but abduction and adduction of the foot are impossible. In this deformity measurements show that the relation of the internal malleolus and the scaphoid are unaltered, and the astragalus can be felt occupying its normal position under the tibia.

If the heel be found to be painful, tender, not displaced, but increased in width, and if on manipulation crepitus be detected in it, there is evidence of a *fracture of the os calcis*. The signs will vary somewhat with the amount of crushing of the bone. If the accident was strong inversion of the foot, which was immediately succeeded by eversion, and the arch of the foot be found flattened, and the malleoli approximated to the tendo Achillis, and there is pain in standing, with crepitus and mobility of a fragment of a bone on the inner side of the os calcis, the signs are believed to indicate a *fracture of the sustentaculum tali.* In some cases a scale of bone on the outer side in connection with the middle slip of the external lateral ligament may be felt detached, movable, and giving crepitus when rubbed against the body of the bone.

If the malleoli be found approximated to the sole, not separated from one another more than the normal distance, and there be no, or but very slight, alteration in the length of the heel or of the anterior part of the foot, there is a *dislocation of the astragalus.* If the bone be displaced forwards, it will be seen and felt projecting under the skin of the dorsum of the foot, and not only its head, but its saddle-shaped upper surface, will be felt; the bone passes forwards and obliquely outwards or inwards. This dislocation may be confounded with the subastragaloid dislocation of the foot backwards and laterally; but it is to be distinguished from the latter by the absence of prominence of the heel, by the depression of the malleoli, by the loss of all flexion movement in the ankle, and by the detection of the upper articular surface of the astragalus, as well as the displaced head of the bone riding on the tarsus. When the astragalus is displaced backwards it will be found lying between the tibia and the tendo Achillis, and rotated. The detection of the displaced astragalus, of course, is necessary to establish the correctness of the diagnosis of this very rare dislocation.

Where the most careful examination fails to show any deformity of the ankle, any alteration in the measurements between the various bony points, or any mobility of any portions of bone, or crepitus, or displacement of any tendons, and yet, as a result of a twist or strain, the part is hot and swelled, movement in it is painful, and pressure in certain parts causes pain, the surgeon is to diagnose a *sprain.* By moving individual *joints separately,* the injured joint will be detected;

and by noting the points of tenderness and the movements which excite most pain, an estimate may be formed of the parts of the articulation which are most injured.

F. **Injuries of the foot.**—Under this head are included all those injuries of the foot which are not attended with deformity about the ankle, and which are therefore not liable to be confounded with fractures and dislocations of that joint. The diagnosis will mainly rest upon the history of the accident, and the existence of pain, loss of power, deformity, abnormal mobility, and crepitus. Œdematous swelling may mask deformity and obscure the other signs of these injuries, and in such cases the formation of the discoloured blebs, so characteristic of fractures of bones, may enable the surgeon to determine upon the existence of a fracture.

(1) When the pain and swelling are located in the instep, and on grasping the front of the foot and rotating or flexing it upon the heel firmly held in the other hand, crepitus is elicited; or when the swelling is great, preventing this manipulation and the observation of the outline of the metatarsus, and dark discoloured blebs arise, the surgeon should diagnose a *fracture of the metatarsus.* The position where the crepitus is felt will determine which bone is broken.

(2) The toes are to be separately examined, and on detecting any deformity, pain or swelling in any one of them, the surgeon should attempt to obtain movement in the length of each phalanx separately; and if he find abnormal mobility and crepitus he of course diagnoses a *fracture of a phalanx.* The last two injuries are produced by direct violence.

(3) If the relations of the heel and the malleoli are normal, but the distance between the malleoli and the bases of the first and fifth metatarsal bones is shortened, and these latter bones are very prominent on the

dorsum of the foot, the sole being preternaturally hollow, there is a *dislocation of the metatarsus upwards.* The internal cuneiform bone may be displaced with the metatarsus forming a marked prominence on the dorsum behind the base of the first metatarsal bone, and extending nearer the ankle than the outer part of the dorsal prominence. If, however, the dorsal prominence be formed by the anterior bones of the tarsus, being abrupt in front instead of behind, as in the former case, and the bases of the metatarsal bones be found lying beneath the tarsus and projecting into the sole, there is a *dislocation of the metatarsus downwards.*

(4) If the middle line of the front of the foot be not in a line with the axis of the leg, ankle, and instep, but be displaced to one or other side, and if the base of the metatarsal bone, towards which it is displaced, be unusually prominent, while the bone on the opposite side of the metatarsus is sunk in and cannot be felt so readily as usual, and if the front of the bone of the tarsus with which it articulates (cuboid or cuneiform) project, there is a *dislocation of the metatarsus laterally.*

(5) If a firm evidently bony projection be found on the dorsum of the foot, corresponding in position and shape to the scaphoid or one of the cuneiform bones, and the corresponding toes or toe be found shortened, the diagnosis of *dislocation of the scaphoid or cuneiform bone* must be made. Similarly, if the little toe be found shortened, the base of its metatarsal bone unduly prominent, and approximated to the outer malleolus, with a depression immediately behind it, and below this depression a bony mass be felt in the sole making the middle of the outer border of the sole project, a *dislocation of the cuboid* bone would be diagnosed.

(6) If at either of the phalangeal joints there be

a deformity (a projection upwards of the base of the phalanx) with fixity of the articulation, there is a *dislocation of a phalanx.* This displacement may be partial or complete, purely dorsal or partly lateral also.

CHAPTER XV.

THE GENERAL DIAGNOSIS OF SWELLINGS AND TUMOURS.

WHEN examining a swelling or tumour for the purpose of arriving at a knowledge of its nature, there are certain general facts to be ascertained and investigated in every case; it is from a knowledge of its exact physical characters that, in most cases, we are able to arrive at a recognition of its vital character. In this chapter it is proposed to examine the bearing of the various features of swellings upon the diagnosis of their nature, and to state the general rules by which the surgeon may be guided in the diagnosis of tumours.

I. The **history of its first appearance** is the first fact to be ascertained in respect of any swelling. This may present several varieties.

(A) **Congenital tumours.**—These include *malformations*, such as meningocele, encephalocele, spina bifida, attached fœtus, included fœtus, congenital dislocations, hydrocele, and hernia; *cystic tumours*, such as dermoid cyst, serous cyst of neck, axilla, perineum, etc., blood cyst, cystic hygroma; *solid tumours*, such as lipoma, fibrous tumour of gum, scalp, skin, sacral and coccygeal tumours; *hypertrophies*, seen particularly in the limbs; *vascular growths*, or the different varieties of nævus; and *thickenings* around bones in cases of intra-uterine fracture.

(B**Swellings arising suddenly.**—Such a swelling can only be caused by (1) the *displacement of parts*, as in dislocations, herniæ, and pneumatocele; (2) *the rapid effusion of blood*, as in traumatic aneurism, hæmatocele, hæmatoma; or (3) *the escape of the contents of the hollow viscera*, as in extravasation of urine.

(1) **The displacement of parts** will be recognised by three signs (*a*) the absence of the part from its normal situation, as *e.g.* the head of the humerus immediately below the acromion, or of the head of the radius below the external condyle of the humerus; (*b*) by the continuity of the swelling with the part supposed to be displaced, as *e.g.* when the swelling produced by a displaced bone moves when the other end of the bone is rotated, or its connection is traced by the finger passed along it, or by certain special signs, as the reducibility and impulse in a hernia, and the respiratory modifications of a pneumatocele (*see* page 145); and (*c*) by the outline and general characters of the swelling resembling those of the displaced organ, as *e.g.* the rounded head of the humerus, the smooth tympanitic gurgling intestine, or the granular omentum.

(2) **The rapid effusion of blood** will be distinguished (*a*) by the absence of the above signs, and also of those associated with the escape of the contents of the hollow viscera; (*b*) by the evidence of the fluid nature of the swelling, shown either by fluctuation or by its infiltrating character, for a rapid infiltration can only be by fluid; (*c*) by signs of bruising or blood staining; (*d*) by the general signs of loss of blood (in some cases); (*e*) in some few cases by evidence of the disturbance of the circulation in the part; and (*f*) by increase in size of the swelling going on for a time at least; this is one of the most important signs of all. Where the effused blood is more or less limited and

circumscribed, but yet forms a distinct tumour, it is called a *hæmatoma;* in such cases the blood is usually poured out from smaller vessels. When, however, it is poured out from a single large vessel, and is not circumscribed but infiltrates the cellular planes of the part, it is spoken of as a *ruptured artery* or *ruptured aneurism.* These may be thus distinguished:

If the swelling be more or less well defined and circumscribed, at first, and perhaps subsequently, fluctuating, without pulsation, bruit, or thrill, and there be no interruption of the pulse in the arteries beyond, and especially if it have resulted from direct violence, it may be diagnosed as a *hæmatoma.*

If the swelling be ill-defined, very tense, of great size, not fluctuating, but more or less boggy at the edges, and the limb beyond be found cold, œdematous, livid, and numb, and the arteries pulseless, and if there be severe pain in the part, with fainting and the other general signs of a severe loss of blood, it is a *diffused aneurism.* A bruit may be heard in such a swelling, at times a thrill may be felt, and if the parts around the fluid blood are much compressed and condensed into a spurious sac, pulsation may be detected, while if the artery be but partially ruptured there may be a faint pulse in the arteries beyond. Often the patient experiences a sensation as of something snapping or giving way, followed by a hot rushing feeling.

If such a swelling have formed as the result of a severe twist, and there be no previous history of any affection of the vessel, it must be diagnosed as a *ruptured artery.* But if the swelling have occurred spontaneously, or from some slight violence, and there be a history of aneurism, or of a swelling or sense of beating in the part, or of pain supposed to be "neuralgic," or of venous engorgement below, then it must be diagnosed to be a *ruptured aneurism.* If unrelieved, this condition speedily runs on to *moist gangrene.*

(3) **Extravasation of urine** is characterised by the position and limits of the swelling; by its occurrence in connection with the act of micturition, and by the œdematous nature of the swelling. (*See* page 502.)

(c) **Swellings arising acutely or rapidly.**— In all cases these are due to an accumulation of excess of the animal fluids or of air in the swelling part, for only these can thus rapidly collect.

Acute inflammation, as it occurs in the cellular tissue, glands, periosteum, tonsil, tongue, larynx, tunica vaginalis, bursæ, synovial membranes, etc., is the most frequent cause of such rapid swelling. It also occurs when a sudden or rapidly-formed obstruction to the venous circulation leads to *passive œdema* of a part, as in thrombosis and compression of veins, and it may occur when some profound change in the character of the blood leads to increased transudation of serum, as in acute nephritis. A swelling is rapidly formed, too, when *small blood-vessels are injured* and blood is poured out, as in some bruises; and in cases of *obstruction of the ducts of actively secreting glands,* the secretion poured out in considerable quantity may accumulate behind the obstruction and lead to a rapid swelling. A good example of this is met with in so-called "milk congestion," where a mammary lobe is distended with its own secretion, and also in acute retention of urine. *Emphysema* of the chest, neck, and face may cause rapid swelling in the fasciæ of these parts. The *coagulation of blood in a vein* (thrombosis) may cause a slight swelling by the clot distending the vein.

Acute inflammation will be readily distinguished by its characteristic local signs: (*a*) redness, when the inflamed part is superficial, (*b*) heat, (*c*) pain, usually severe, and (*d*) tenderness; and (*e*) by *general fever.*

Œdema is recognised by the pitting of the swollen part on pressure; when a swelling is wholly œdematous, it can be entirely obliterated at any one spot by properly applied pressure. If due to venous obstruction it is limited in area, and there is generally more or less lividity of the surface and distension of the veins; if due to altered blood condition, it is general in distribution, and there is no lividity, but on the contrary marked pallor.

Extravasation of blood is distinguished (*a*) by the discoloration of the part, which cannot be altered by pressure, and which undergoes the characteristic colour-changes of a bruise; (*b*) by the ill-defined character of the swelling; and (*c*) by the history of an injury or strain.

A distended gland is recognised (*a*) by the position of the swelling (at the site of a gland), and (*b*) by the outline of the swelling corresponding exactly to that of the gland; this is observed in milk congestion and in distension of the submaxillary gland from salivary calculus, when each lobule of the gland can be felt; a distended bladder is recognised by the same general characters.

A venous thrombus is characterised by (*a*) its position, in the course of a vein; (*b*) its shape, cylindrical, with or without rounded projections corresponding to pouchings of the vein; (*c*) its firmness; (*d*) and when mobile at all, by the mobility being limited to the transverse direction. The manipulation of a suspected thrombus must be very gentle and careful, lest a part of it be detached.

(D) **Swellings slowly formed** or *chronic swellings.* Such swellings may be caused by accumulation of the fluids of the part, or by an increase of the formed elements, or by both. Chronic swellings are caused by (*a*) *chronic inflammation*; (*b*) *œdema due to* gradually produced alteration in the character of the blood or obstruction to the venous circulation; (*c*) *active congestion*, or increased supply of blood to a part, *e.g.* exophthalmic goître; (*d*) *yielding of vessels to intravascular pressure, e.g.* aneurism, varix; (*e*) *accumulation of secretion* in a closed sac, or behind an obstructed gland-duct, *e.g.* cystic goître, bursal cysts, sebaceous cysts, galactocele; (*f*) *gradual displacement* of organs, *e.g.* spinal curvature, exophthalmos, many herniæ; (*g*) *hypertrophy, e.g.* of mamma, tonsil, prostate; (*h*) *tumours* proper, or *new growths.*

Chronic inflammation is generally characterised by (*a*) gradual increase of the swelling, (*b*) its infiltrating character, (*c*) pain especially elicited by pressure or by use of the part, and (*d*), in some cases, local heat, (*e*) alteration in the consistence of the tissue, either induration or softening, (*f*) impaired function of the part, (*g*) in some cases pyrexia. To distinguish between the results of chronic inflammation and hypertrophy is oftentimes a matter of very great difficulty.

Œdema, when chronic, has the same characters as when acute. (*See* page 243.) The so-called "solid œdema" does not pit on pressure, and is allied to chronic inflammation.

Active congestion is a frequent cause of physiological swelling, but is rarely a pathological cause. Its characteristics are (*a*) moderate enlargement, (*b*) variations in the size of the swelling from time to time, (*c*) enlargement and increased pulsation of the supplying arteries, (*d*) redness of the part if superficial, (*e*) sometimes a murmur. These signs are found in exophthalmic goître. (*See* page 434).

Dilatation of an artery is to be recognised (*a*) by the position of the swelling in the course of and fixed *to an artery*, (*b*) by the tumour having an expansile *pulsation* in it synchronous with the ventricular systole, often accompanied by a murmur and a thrill, and (*c*) by weakening and delay of the pulse in the artery beyond. (*See* page 264, *et seq.*)

Dilatation of a vein is known by the (*a*) position of the swelling in the course of a vein or veins; it is most common in the lower limbs, scrotum, and anus; (*b*) the elongated and often tortuous, or even sacculated character of the swelling; (*c*) its compressibility and reducibility; (*d*) where superficial, the livid colour of the enlargement. It is frequently accompanied with œdema; when there is a direct communication between an artery and the dilated vein, the latter exhibits pulsation, bruit, and thrill. (*See* Aneurismal varix.)

Accumulation of secretion is recognised (*a*) by the occurrence of the tumour in the position of, or actually in, a gland or closed sac; (*b*) by its more or less globular outline; (*c*) by the fluidity of its contents as evidenced by fluctuation; (*d*) by the absence of the usual signs of inflammation; (*e*) by the nature of the contents of the swelling as shown by an exploratory puncture.

Displacement of organs. (*See* page 240.)

Hypertrophy occurs most often congenitally, or in early life, but a notable exception is found in the prostate. Its general features are (*a*) a uniform painless enlargement of the part or organ, which after attaining a certain size may remain stationary; (*b*) unaltered consistence; (*c*) the function of the part is not interfered with, except in some cases from its mere bulk; (*d*) absence of heat, redness, and degenerative changes.

New growths vary very much in their features, but they are to be generally recognised by (*a*) their continuous growth, which may be slow or rapid; some tumours may become stationary; (*b*) the abrupt limitation of their outline; (*c*) absence of local heat, redness, pain, œdema, and absence of fever; exceptions in all these particulars are met with; (*d*) apparently spontaneous formation in most cases; (*e*) resistance to treatment other than excision.

(E) **Traumatic swellings.**—In many cases a swelling more or less directly follows an injury. Injury can cause swelling (*a*) by *displacement of parts*, as in herniæ, fractures, and dislocations; (*b*) by *rupture of vessels*, as in fractures, bruises, and hæmatoma; (*c*) by exciting *inflammation*, acute or chronic, as in acute orchitis from a blow, and in chronic arthritis from a fall; (*d*) by the effusion of plastic lymph in the process of repair, as the callus around a fracture; (*e*) and probably by exciting the *development of a new growth.*

(F) **Intermittent swellings.**—Intermittent appearance is a not infrequent characteristic of swellings caused by *displaced viscera* or *structures*, as herniæ, rectal polypus, prolapsus ani and prolapsus uteri; by *slight œdema*, as in the swelling of the ankles, noticed only in the evening; and by *venous distensions*, as in varices appearing only during pregnancy, and piles.

II. The **progress or subsequent course** of the tumour is the second fact of importance to ascertain. Attention should be paid to several particulars.

(1) **A tumour may remain stationary** even for years; this of course indicates an entire absence of formative activity, and is chiefly of importance as evidence of the absence of "malignity" or of active inflammation. A tumour long stationary may again enlarge, as when inflammation attacks a caseated gland; or if a simple tumour become "malignant," as when a wart develops into an epithelioma. This always indicates a change in the nature of the swelling.

(2) **A tumour may diminish** in size. This, too, is a favourable sign. If *gradual*, it indicates

absorption of the elements of the swelling, whether fluid, as blood, serum, and pus, or solid, as granulation tissue, fibrin, bone; or a shrinkage from some retrograde nutritive change, as in the caseation and calcification of inflamed glands, and the contraction of "withering scirrhus." The gradual shrinking of a swelling is a fact in favour of its being either an effusion of blood or lymph, the result of an injury or of inflammation. If it occur *suddenly*, it indicates the escape of the contents of the swelling, usually fluid, as in some cases of hydronephrosis or pyonephrosis; other examples are afforded by the disappearance of a bladder tumour on catheterisation, and of the uterine tumour after parturition.

(3) **A tumour may suddenly increase** in size. This is caused by the onset of *acute inflammation* in or around it, *e.g.* inflamed pile; by *effusion of blood* into it, as in the conversion of a hydrocele into a hydrohæmatocele; or by increased *displacement of organs*, as in hernia.

(4) **A tumour may continuously increase,** and this increase may be slow or rapid. The rate of increase depends upon the relation between the intensity of the cause of the enlargement, and the hindrances to that enlargement. Where the *swelling increases slowly*, it is due either to a *feeble tendency to enlargement*, as in chronic inflammation and in the more benign tumours, lipoma, etc., or to *considerable resistance to enlargement*, as in aneurism, varix, and intraosseous tumours and inflammations. Where the swelling *increases rapidly* it indicates a *great inherent power of growth* in the tumour, as in acute inflammation, soft malignant tumours, and some cysts; or a *feeble resistance* to enlargement, as in œdema of cellular tissue. A continuous enlargement of a solid tumour without alteration in consistence is an important characteristic of malignant disease.

(5) **A swelling may enlarge intermittently.**—This is met with in (*a*) *displacement of viscera;* when under the influence of strain further displacement occurs from time to time, as in hernia, prolapsus ani, spina bifida, meningocele; (*b*) *successive attacks of inflammation*, as in some cases of adenitis and tonsillitis; (*c*) *vascular enlargements*, either active or passive, as in exophthalmic goître (where it is due to intermittent arterial dilatation), varix, and venous nævus (where it is due to intermittent venous obstruction), *e.g.* successive pregnancies, coughing, or crying.

(6) **A tumour may change its position.**—This is observed in fatty tumours, which have been known to travel in the subcutaneous tissue of the back from the shoulders towards the buttock; the movement is never in a direction contrary to gravity. More often we see that as a tumour enlarges, it appears to change its position, owing to the growth taking place in one special direction. Thus an inguinal hernia may at first cause a swelling in the groin, but as it enlarges it passes into the scrotum, and so distends that sac that the small inguinal swelling is obscured. In certain abscesses the same thing is noticed; thus an ilio-psoas abscess may first bulge above the fold of the groin, and then later on point in the thigh by a swelling so prominent as to render less evident the one higher up.

(7) **The direction in which a tumour enlarges** is often a matter of considerable diagnostic value. It is an indication either of the direction of least resistance to the growing tumour, and so shows its relation to some of the stronger and more resistant fasciæ of the part, as in psoas and iliac abscess, hernia, extravasation of urine, synovitis, bursitis, and many other tumours; or it indicates the affection of some particular tissue, as in diffuse lipoma, where the fatty tissue alone is involved, in adenoma,

where lymphatic glands alone are enlarged, and in varicose veins.

(8) **A tumour may enlarge in one or both of two ways,** either by the continuous growth or expansion of the primary swelling, or by the development of separate swellings, which then become incorporated with the original growth. The first is exemplified in the growth of aneurisms, cysts, and most solid tumours. The second is seen in some cases of malignant tumour, where detached nodules may form in the skin or in lymphatic glands, and, enlarging, coalesce into one mass; and in some chronic inflammations, as in the glandular enlargements in adénie, in osseous nodes, and in gummata.

(9) **A tumour, as it enlarges, may ulcerate.** Of this two varieties are to be distinguished. In some cases the skin over a large tumour ulcerates, either from distension or from constant friction. In such cases the skin thinned (not adherent to the tumour if it have not sprung from the skin, as in molluscum fibrosum), the swelling is always very large, and not attended with fungus or deep ulceration of the mass. We see this occasionally in the case of large herniæ, or hernia for which an improperly powerful truss has been worn; in large fatty tumours, and other very large growths. In the other class of cases, the ulceration is caused by molecular disintegration of the tissue of the tumour itself, and is therefore independent, in many cases, of the size of the mass, and is an important indication of the vital condition of the tumour. Such ulcers are deep, or at any rate not limited to the skin, but involve the tumour itself; the skin, or mucous membrane, is adherent to and involved in the mass, and often there is more or less fungous protrusion of the mass. We see illustrations of this in cases of epithelioma, and other carcinomata, sarcomata, gummata, lupus, scrofulides, actinomycosis, etc.

A sarcomatous fungus is often distinguishable from a cancerous one by the fact that the edge of the ulcerated skin is not infiltrated by or adherent to the tumour; carcinoma always involves the skin around the fungus.

(10) **A swelling may alter in consistence,** becoming firmer or softer. *Increased firmness* may be due to (*a*) increased tension, in which case it always accompanies enlargement of the swelling, *e.g.* hydrocele, strangulated or obstructed hernia; (*b*) to solidification of fluid contents, as the coagulation of the blood in a hæmatoma or an aneurism, or the separation of fibrin in an aneurism; (*c*) to organisation of a softer cellular exudation or growth, *e.g.* ossification of callus, of a node or of an enchondroma; (*d*) to absorption of the fluid parts of swellings, *e.g.* resolution of inflammation; (*e*) or to calcification of a thrombus. In the last four instances, except in some cases of aneurism, the induration is accompanied with shrinking of the swelling. *Softening of a swelling* is due to (*a*) liquefaction of its solid parts, as in the formation and progress of an abscess, and in the disintegration of tumours; (*b*) to destruction of firm, resisting structures, as bone and fascia, as in the growth of central tumours of bone, etc.; these are attended with increased size; (*c*) or to lessened tension from absorption, as in serous and synovial effusions, etc.; this is associated with lessened bulk of the swelling, and indicates resolution of the swelling, and at once eliminates many forms of tumour.

III. **The position of a swelling** is a fact of great importance for diagnosis. By "position" is meant the regional localisation of a swelling, *e.g.* on the head, in the axilla, the back, the scrotum, the ham, etc. The possible affections of a region are limited in kind by the structures there existing.

(1) The position of a swelling is of *negative value*

in the exclusion of certain tumours. Thus, a swelling in the ham cannot be a strangulated hernia, or a spina bifida.

(2) It is also of great *positive value* in deciding the nature of a tumour, as examples of which I need only mention such cases as housemaid's knee, enlarged glands, varicocele, syphilitic ulceration, and enlarged testicle. The importance of this part of our subject is exemplified in the chapters devoted to the diagnosis of local affections.

IV. **The connections of a swelling,** by which is meant its relations with the individual component tissues and structures of a part, is a fact without which a diagnosis cannot be complete. While some pathological processes, such as inflammation, may attack any tissue, others, such as tumour and cyst formations, are limited to certain tissues and organs; and different varieties of inflammation are met with in different tissues.

The *connection of a tumour* is determined (*a*) by its exact *position*, as in psoas and lumbar abscess, extravasation of urine, tenosynovitis, bursitis, varix, etc.; (*b*) by *its shape*, corresponding to that of the structures affected, as in the case of synovial effusions. tenosynovitis, epididymitis, glandular enlargements, varix, thrombosis; (*c*) by its *adhesion* to one or more of the tissues of a part, as shown by the immobility of the tumour apart from the tissue or organ affected, and *vice versâ ;* this is a sign of considerable importance and of wide application.

Nearly all the normal tissues of the body allow of a certain amount of movement one upon the other; muscles move over each other and over bones ; the skin is movable over muscles, deep fascia, and, bone. The exceptions are in the case of the structures forming the scalp, the mucous covering of the hard palate, the gums, the teeth, the skin of the palm and sole, the sheaths of muscles, and the periosteum, which are not movable over the subjacent parts. Adhesion of a swelling to a tissue may be *real*, as in the case of an exostosis, a gumma in muscle, or a wart on the skin; or it may be only *apparent*, as in the case of parosteal tumours, hydrocele, and fatty tumour, the swelling being so firmly bound down that it has no independent movement. The adhesion may be *primary*, the tumour actually springing from the tissue, as in the case of aneurism, sebaceous cyst, gumma, exostosis; or it may be *secondary*, occasioned only by the growth of the tumour, as in abscesses gradually reaching the surface, and in malignant tumours of all kinds, which, by their infiltrating mode of growth, become adherent to surrounding tissues as they enlarge. The adhesion or connection of a swelling with more than one tissue is an especial feature of inflammatory and malignant tumours.

Adhesion to the *skin* is sometimes obvious at a glance, as in the case of cutaneous warts. In the case of deeper swellings, it is to be tested by attempting to glide the skin over the swelling which is held fixed, and by pinching the skin up in a fold over every part of the surface. It must be borne in mind that a tumour of large size by mere tension considerably lessens the natural mobility of skin.

Connection with the *subcutaneous tissue* is shown by the mobility of the tumour under the skin and over the muscles, or other deeper tissues. The best example of such a tumour is the common lipoma, or fatty tumour. As the skin is normally connected with the subcutaneous fat by fine fibrous processes continuous with the dissepiments of the fat, such tumours show a slight dimpling of the skin over the tumour when it is pinched up.

Adhesion to the *deep fascia* of a part may be determined by the mobility of a tumour over the subjacent muscle and under the skin, by its being less movable than a tumour in the loose subcutaneous tissue, and by its being fixed when the deep fascia is made tense, and more movable when it is relaxed.

Adhesion to *muscle* is detected by putting the suspected muscle in action, when the tumour will move with the muscle; and, further, by noticing that while the tumour is movable over bone, it is deeper than the skin and subcutaneous fat, and perhaps not adherent to them. The mobility of the tumour is much greater when the muscle is relaxed than when it is firmly contracted.

Adhesion to a *vessel* is diagnosed by noticing that the tumour, while movable over skin, muscle, and bone, is yet not freely movable along the line of a vessel, although it may be movable transversely.

The mobility of *nerve-swellings*, or neuromata, is characteristic; for while it is free in the direction transverse to the long axis of the swelling or of the nerve, there is no mobility in the length of the nerve. This is similar to what is observed in connection with vessels, but is more striking, as the mobility of neuromata in the transverse direction is greater than is that of aneurisms, thrombi, or phleboliths.

Adhesion to *bone* is determined by the immobility of the tumour apart from the bone. Apparent mobility of a fixed tumour may be caused by its elasticity, or by the mobility of structures over it, as, for example, in the case of an exostosis of the femur with a large movable bursa developed upon it. Care in examination will, of course, preclude error from either of these sources.

The adhesion of a tumour to *a gland*, *e.g.* the breast, is determined by seizing the gland in one hand and the *tumour* in the other, and attempting to move one without the other. This sign is of great importance in the diagnosis of mammary tumours, particularly in the separation of simple and malignant growths.

The range of mobility of a swelling or lump may determine its position; as, for instance, in the case of a loose body in a joint, bursa, or the tunica vaginalis.

Mobility during certain acts may determine the connection of a tumour with some tissue or organ only moving them. A good illustration of this is the rise and fall of a goître during deglutition.

V. **The consistence of a tumour** may be uniform or varied; it is important to distinguish between gaseous, liquid, and solid swellings. Gas may be present in a tumour (*a*) being contained in one of the gas-containing viscera (lungs, stomach, intestines), as in pneumatocele and hernia; or (*b*) having escaped from one of these viscera, as in cutaneous emphysema; or (*c*) having arisen from decomposition, as in some cases of moist gangrene. In gangrene the *bubbles of gas may be seen* in the superficial bullæ and veins. Where the gas is contained in the connective tissue spaces it gives a *fine dry crackling* sensation, and the swelling yields when compressed; this is best observed in subcutaneous emphysema, and is less well shown in some cases of moist gangrene. Where the gas is mixed with liquid, its manipulation gives *a gurgling sound*, which is often perceived in the reduction of a hernia. But the most important physical sign of the presence of gas is a *tympanitic percussion note;* this is only obtained when the gas is present in sufficient proportion, as in pneumatocele, subcutaneous emphysema, tympanites, and enterocele.

The presence of fluid in a tumour is determined by one of three signs, fluctuation, fluctuation *wave, and pitting* on pressure. As these are signs of much importance, special attention must be devoted to them.

Fluctuation is the name sometimes given to two distinct impressions, which should be distinguished as "fluctuation" and "fluctuation wave." To observe "fluctuation" place the balls of the fingers gently but firmly on one side of the swelling, and then with the fingers of the other hand gently press into the tumour; if the tumour be felt to rise under the fingers of the first hand it is due to the presence of fluid, and this sensation is *fluctuation.* The precautions to observe in reference to this sign are: (*a*) always to use two hands; the manipulation should never be conducted with the fingers of one hand only, as it is then very liable to mislead; (*b*) to be careful to fix the tumour with one hand, so that the pressure of the other does not move it *en masse*, but, if liquid, merely displaces a part of its contents; the unpractised observer may easily mistake mobility of a tumour for fluctuation, unless this error be guarded against; (*c*) one hand only should be used to compress the tumour, the other being placed immovably on the swelling; if the two hands are both moved, errors are very easily made; there is, of course, no objection to alternate the hands, but there is no possible advantage in so doing; (*d*) fluctuation should always be obtained in at least two different directions across a swelling; in collections of fluid the displacement occurs equally in all directions; in some solid tumours a sense of fluctuation may be obtained in one direction only, but not in more than one, as across muscle, for example; in narrow elongated collections of fluid, as in tenosynovitis, it may be difficult or even impossible to obtain this sign across the swelling, owing to its narrowness; (*e*) care must be taken not to mistake mere elasticity or compressibility for a *sense of* fluctuation; this is best avoided by noticing that the sign is detected by the stationary hand, not by the compressing hand, and it is not the fact that the tumour yields to pressure, but that its contents are displaced and press up the other hand, that constitutes fluctuation. It requires practice and skill to detect fluid in small quantity or at a considerable depth, and where doubt is entertained it should always be removed by puncturing the swelling with a grooved needle, or, better, a syringe.

It may be well to enumerate the errors that may be made in connection with this very important sign.

The surgeon may fail to obtain the sense of fluctuation

(1) Because of the great depth of the fluid;
(2) Because of the small size of the swelling rendering the manipulation very difficult;
(3) Because of the extreme tension of the fluid;
(4) Because of the extreme lack of tension of the fluid.

He may wrongly suppose that he obtains the sense of fluctuation

(1) If the tumour be very elastic;
(2) If the tumour be very soft;
(3) If the tumour be very movable.

For the diagnosis of fluctuating swellings *see* pages 290 *et seq.*

If the fluid of a tumour contain numerous small solid bodies, the displacement of these in obtaining fluctuation may give rise to a very characteristic kind of *fremitus.* This sign enables the surgeon to detect the presence of "melon-seed bodies" in "ganglion." In some cases of hydatid tumour, if the left hand be placed on the swelling and percussed with the right, a fine thrill or fremitus is perceived (called the *hydatid fremitus*), which is attributed to vibrations set up by the impact of the daughter cysts in the *mother* sac. On listening over a hydatid tumour when thus percussed a musical sound may sometimes be perceived.

A fluctuation wave is obtained in cases of large collections of fluid, with more or less tense walls, as in unilocular ovarian cyst and ascites. It is obtained by placing the palm of the hand smoothly over one side of the swelling, and then sharply tapping the opposite side of it with a finger or fingers of the other hand, when a distinct wave may be felt, as it were, to strike the palm. This sign should be obtained across more than one diameter of the tumour, and care should be taken not to mistake a mere impulse or wave conveyed along the covering of the tumour for a wave transmitted through it; the former is never such a sharp abrupt impulse as the true fluctuation wave, but it may be entirely eliminated by gently pressing upon the coverings somewhere between the two hands. In the case of the belly this is usually done by getting an assistant to press the edge of his hand on the walls between the hands of the surgeon, and so interrupt any wave passing that way. The character of the fluctuation wave differs somewhat with the consistence of the fluid transmitting it, and so affords some criterion of its nature.

Pitting on pressure.—If, on pressing a finger into a swelling, it yields under it and leave a pit which is gradually filled up again when the pressure is removed, the phenomenon is known as "pitting on pressure." This is due to fluid or gas infiltrating the cellular tissue; when fluid, the swelling is dull on percussion and the pitting is unattended with any other sensation; when due to gas it may be tympanitic on percussion, and it gives a fine crackling sensation to the finger, as already mentioned (page 254); a gaseous swelling is also more elastic than fluid. This condition of fluid infiltration of cellular tissue is known as *œdema*. It may also be recognised, but not so surely, by a lessening or total obliteration of the natural wrinkles of the part. **Œdema** is caused by (*a*) *acute inflammation*, (*b*) *venous obstruction*, (*c*) *hydræmia*, (*d*) *urinary infiltration*. If *inflammatory*, it is localised, and accompanied by the usual signs of inflammation, *i.e.* pain, tenderness, heat, and fever, and usually redness; much surrounding œdema is sometimes an useful indication that the inflammation has run on to suppuration. When due to *venous obstruction* it is generally localised, and attended with some lividity of the surface or venous distension, and the obstruction may be obvious, as a tight bandage, an aneurism or other tumour, or pulmonary or cardiac disease. If due to *hydræmia* it is always associated with marked anæmia, is painless, and when severe is more or less general. The peculiar limits of urinary infiltration sufficiently characterise that form of œdema. The limits and extent of œdema should always be carefully ascertained; where local it owns a local cause, and *vice versâ*. Swellings caused by fluid yield, of course, a dull percussion note.

Swellings which are dull on percussion, and neither fluctuate nor pit on pressure, are solid.

Solid tumours may be soft, easily yielding to pressure, sometimes requiring care to distinguish from fluid tumours. Examples of such are seen in lipoma and myxoma. Or they may be of any consistence firmer than this, up to the incompressible hardness of bone. Of the firm tumours may be mentioned fibroma, adenoma, and many sarcomata; of the very firm, but still slightly elastic and compressible tumours are enchondroma and scirrhus; cartilaginous tumours only yield very slightly to pressure, and the recoil is very rapid; of the absolutely hard unyielding swellings we have osteoma, calcified tumours such as phleboliths, and swellings due to calculi. In examining the consistence of a solid tumour, a peculiar crackling may be met with; where this is very dry and high-pitched, like the sensation produced by compressing a cracked egg, it is known as "egg-shell crackling," and is caused by the yielding of a very thin plate or shell of bone over a softer tumour. A similar sensation, but less dry, and of a lower pitch, is produced by the like yielding of a thin plate of cartilage. This sign is a useful indication of the expansion of the bone by a tumour growing in its interior (sarcoma or enchondroma), and if it affect the articular end of a bone, while at the same time it expands the cartilage-covered surface of the bone, the softer sensation may be felt. The author has recently noticed this in a case of soft sarcoma growing from the outer condyle of the femur. A very similar sensation may be felt in cases of subperiosteal cephalhæmatoma, where the pericranium becomes thickened by soft callus, and bends like stiff parchment under the finger.

As already stated, swellings may vary in consistence in different parts or at different times, and a knowledge of this fact may aid in the diagnosis. The association of firmer and softer solid material in one swelling indicates sometimes that a soft tumour, growing within a hard substance, has at one or more places burst through the enveloping tissue; this is sometimes observed in the growth of central sarcoma of bone. At other times it shows that the soft tissue has undergone some indurating change, as when a sarcoma chondrifies or ossifies; while in other swellings it indicates that the tumour is composed of quite different constituents, as intestine and omentum in a single hernial sac. Still more common is the association of solid and fluid parts in one swelling. Where, with signs of inflammation, part or parts of a solid swelling become fluctuating, suppuration may be recognised. Where, on the other hand, such a change takes place without any indication of inflammation, a degenerative softening of the tumour, or a growth of a cyst or cysts, is the cause; and the distinction between these may be difficult, but the more tense and the more globular the collection of fluid the more likely is it to be a true cyst, and not a collection of soft detritus. The causes of the changes in the consistence of tumours have already been mentioned. The association of cystic and solid matter in a tumour is characteristic of cystic hygroma, cystic sarcocele, and many other tumours; variation in their consistence, while a frequent feature of malignant tumours, especially sarcomata, is rarely seen in benign growths. (For the diagnosis of solid tumours, *see* pages 279 *et seq.*)

VI. **The form of a tumour** must be carefully observed, as it not unfrequently aids very materially in the diagnosis.

(1) *A tumour or swelling may have the form* of one of the *normal structures of the body*, and so prove its relation with such structure; many examples of this might be cited, but the fact is of practical diagnostic value in the following instances: enlargement of lymphatic glands, enlargement of the salivary glands, varix, thrombosis, phleboliths, arteritis, fusiform aneurism, synovitis, bursitis, hydrocele, sarcocele, misplaced testicle or ovary, movable kidney, enlarged liver or spleen, distended bladder or uterus, and various dislocations.

(2) *A globular shape* of a neoplasm indicates the uniform yielding of the implicated tissues to the pressure of the growth, or the general implication of all tissues equally in a rapidly-growing tumour. Thus we find that cysts of all kinds tend to assume a globular outline, so also do sacculated aneurisms; diseased joints when the fibrous structures are softened and are no longer able to maintain the normal out*line of the part,* while soft sarcoma and carcinoma

frequently assume a globular shape. The globular form of dermoid or sebaceous cysts generally distinguishes these swellings from ovoid fatty tumours and hemispherical abscesses.

(3) *A tumour may be lobulated*, and this may be characteristic. Thus the fine lobulation caused by the distension of the acini of the mamma in milk congestion, or of the lobules of the submaxillary gland in obstruction of the duct by a calculus, are quite characteristic of glandular distension. The flattened ovoid lobulation of a fatty tumour is also distinctive; and the presence of omentum in a hernial sac is usually easily determined by its granular and loosely lobulated feel. Coarser lobulation of tumours may be due to yielding of the surrounding tissue in certain directions only, as in some ganglia; to cystic formation, as in cystic sarcoma of the mamma and testicle; or to an inherent mode of growth of the tumour, as in enchondroma, which has a special tendency to form botryoidal masses. Lobulation may also be explained by the anatomical relation of the swelling, as in psoas abscess.

(4) The *retraction* of a tumour is an important feature, indicating a contraction of the tissue; it is a special feature of scirrhous carcinoma.

(5) Other characteristic forms are the *warty* or *villous*, the *pedunculated* or *polypoid*.

VII. **Translucency** of a swelling shows that it consists of a collection of transparent fluid, serous or synovial; and it is, therefore, a diagnostic sign of great importance. To test for translucency, the tumour should be grasped so that it is made tense and the skin is stretched tightly over it; a good light is then to be held close to it on one side, while the observer's eye is on the opposite side, the rays of light which pass over the surface of the swelling being shut off by the hand or some suitable screen; if translucent, the light is seen through the swelling more or less intensely. Some prefer to look through a stethoscope, a roll of paper, or some similar tube. Translucency may be missed by carelessness in carrying out this manœuvre; thus, a scrotal swelling may be so held that the patient's penis, or the sound testicle, or the surgeon's hand is placed between the light and it, and the rays of light effectually interrupted; or one part only of a swelling, which is partly solid and partly fluid, such as an hydrosarcocele, may be examined. On the other hand, it may be wrongly detected, if the observer be not careful to shut off from his eye all the rays of light except those passing into the swelling, thus, if a stethoscope or other tube be used and the end be not placed quite firmly and uniformly on the swelling, light passing into the tube under its tilted end may be mistaken for that passing through the swelling. Tumours usually translucent may be opaque through great thickening of their coverings, as in some old cases of hydrocele; or through a change in their fluid, as when hæmorrhage occurs into a hydrocele, or a spina bifida becomes filled with organisable lymph, or a serous cyst becomes inflamed and suppurates. When testing for translucency, it is well always to examine the whole swelling, both because a translucent part may otherwise be overlooked, and also to localise exactly any opaque portions. In this way the position and approximate size of the testicle in a hydrocele, or the presence and position of the spinal cord or nerves in a spina bifida, may be determined. While translucency is positive evidence of the presence of a clear fluid in the swelling, serous or synovial, the surgeon must remember that opacity is not by itself evidence of the absence of such fluid.

Transparency of the coverings of a tumour, the result of thinning, is sometimes of use in diagnosis *when the colour* and appearance of the swelling seen through are characteristic, as *e.g.* in the pointing of an abscess, many cases of spina bifida with very thin sacs, nævi, sebaceous cysts, and dilated veins.

VIII. **The colour and vascular condition of the skin** covering a swelling are often noteworthy.

(1) The skin may be *white* and blanched, as in œdema from Bright's disease, or anæmia.

(2) The skin may be *reddened*, and if so, care must be taken to distinguish between certain varieties of this discoloration. If the colour be neither banished nor altered by pressure, it is due to escape of blood from the vessels, the result being spoken of as petechiæ if in small isolated spots, or as a bruise or an ecchymosis if more diffused; such a condition aids in the diagnosis of purpura, scurvy, hæmatoma, bruise, or the rupture of an artery or a vein. If, however, the colour disappear on pressure, it shows that this is due to blood circulating in the vessels, and the rapidity with which it returns corresponds with the activity of the circulation in the part. When the red colour is uniform and the individual dilated vessels cannot be detected, this condition is due to capillary dilatation, is very often inflammatory in nature, and hence may aid in the diagnosis of the tumour, as in the case of an acute abscess; such inflammatory redness of the skin, however, may be of secondary origin, *e.g.* the intertrigo over a large scrotal or umbilical hernia, or large pendulous fatty tumour. If the colour be not thus uniform, but the individual vessels can be seen with clear spaces between them, the hyperæmia is limited to vessels larger than capillaries, and is certainly not inflammatory; if of a purple tint it is probably due to obstruction to the venous circulation. Where, however, this dilatation of vessels larger than capillaries containing blood of a bright red colour is seen over malignant tumours it indicates the

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involvement of the skin in the morbid growth; this is seen very characteristically in some cases of cancer of the breast. When the bright capillary inflammatory redness is associated with œdema it is a useful sign of suppuration; the redness of inflammation is always accompanied by increased local heat. (*See* page 20.)

To be carefully distinguished from the above forms of redness is the *nævoid condition,* the appearance of which is quite characteristic; the colour varies from bright to dark red, the affected skin is slightly raised, always sharply defined, and often presents an uneven appearance from the looped and pouched arrangement of the vessels; further, this condition of skin is congenital, or appears soon after birth. Such a state of the skin indicates that any subjacent swelling is either a nævus or some other form of congenital tumour.

(3) The skin may be *pigmented.* This is met with as a congenital deformity in hairy moles, or results from the degeneration of nævi; in each case there are a long history, dating back to birth or infancy, a deep colour, sharp outline, and often an abnormal growth of hair or of the papillæ of the part, while in each case it would point to a nævoid or congenital nature of any subjacent tumour. Pigmentation also results from prolonged congestion, and is then less defined and shades away at the edge, unlike a hairy mole. Possibly the characteristic discoloration of the skin in Addison's disease might be met with over a tumour; it would have no diagnostic significance *quoad* tumour. The hairy or pigmented moles frequently become the seat of epithelioma, and this fact might aid in the diagnosis of commencing epithelioma.

(4) The skin may be so thinned as to allow the colour and form of the parts within to be seen.

(5) The skin may be quite unaffected.

IX. **Pulsation** is sometimes present in tumours, and is of the utmost importance as a symptom, for in all cases the special connection with the arterial system that it indicates requires careful investigation. It must be noted at the outset that only when the passage of blood into a part meets with a certain amount of resistance is pulsation to be observed; thus, when an aneurism or an artery ruptures subcutaneously and the blood is diffused in the loose tissue of the part there may be no pulsation in the swelling. Pulsation in a swelling may be due to (*a*) the direct communication of an artery with the swelling, as in aneurism, aneurismal varix, pulsating proptosis; (*b*) to the presence of numerous pulsating arteries in the tumour, as in aneurism by anastomosis, and in very vascular sarcoma, hence called "pulsating tumour;" (*c*) to the presence of an artery in close contact with the swelling, to which it transmits its pulsation, as in some cases of enlargement of popliteal glands, and of tumours of the thyroid gland and some abdominal tumours. The fact of chief importance in connection with any tumour that pulsates is to determine whether an artery directly communicates with it, whether it is an aneurism. (For the diagnosis of pulsating tumours, *see* pages 296 *et seq.*)

X. We will here speak of the *other phenomena connected with the vascular system* that may be met with in tumours. Of these, the first is

(1) **A bruit,** or murmur, a sound audible when the ear is applied directly to or with a stethoscope over a swelling. It may be caused either by the rush of blood into an aneurism, and in some cases also out of the sac, or by the partial compression of an artery by a swelling placed over it, and this particularly in certain blood states. It is heard simultaneously with the pulse, but may be also diastolic in cases of aneurism. It varies much in character, being described by such terms as soft, loud, blowing, rough, musical, etc. In aneurisms it is generally of a blowing character; in

partial compression of an artery it is usually a dull toneless sound, or "thud," or it may be rough in character. The points to notice in regard to a bruit are (*a*) the time of its occurrence; (*b*) if it be intensified by pressure; (*c*) if it be heard of equal intensity all over the swelling, and with the pressure of the stethoscope in any direction; (*d*) if heard at a distance. Only in aneurismal tumours do we hear both a systolic and a diastolic bruit. An aneurismal bruit is not intensified by pressure; one due to compression of the artery is intensified by moderate pressure in the direction of the artery; an aneurismal bruit is heard equally well all over the tumour; an arterial bruit is heard loudest, and perhaps only, just along the line of the artery; an aneurismal bruit is often conducted along the diseased artery, or is heard at a distance, as over the back in aortic aneurism; a "compression murmur" is not thus conducted.

(2) **A thrill** is a vibrating sensation, detected by the fingers lightly placed over the part; it is caused by the forcible passage of blood through a small orifice. It is felt in many cases of aneurism and in cases of direct communication between an artery and a vein. In aneurism it is limited to the tumour, and its presence depends upon the relative size and conformation of the mouth of the sac, and possibly, too, upon the condition of the interior of the sac. In aneurismal varix the thrill is often very intense, and is particularly characterised by its wide extent, being conducted and felt in some cases along the veins of a whole extremity. In certain conditions of the arterial wall and possibly also of the circulating blood, a thrill can be produced by compression of an artery against a firm tumour or a bone; this thrill is increased by gentle pressure.

(3) **The arterial pulse** on the distal side of *a tumour* should always be noticed. In the case

of an aneurism, the pulse in the vessel beyond is delayed and rendered smaller and of less tension than in the corresponding artery of the other side. These differences are usually quite perceptible to the finger, but the alteration of tension can be best demonstrated by a carefully taken sphygmographic tracing. Sometimes, beyond an aneurism, the usual arterial pulse is entirely lost from embolism or thrombosis, or from the tumour obliterating the mouth of an artery. The complete subcutaneous rupture of an artery is always attended with the abolition of the arterial pulse below. An examination of the superficial arteries is of use to throw light upon the general condition of these vessels; the superficial temporal, brachial, radial, and common femoral arteries are those most easily seen and felt, and if they be tortuous, with a visible pulsation causing their locomotion, and the tubes be hard and incompressible, and especially if, when the finger is gently passed along them, it detect slight unevenness in them, it may be taken as evidence that the arteries of the body generally have undergone the degenerative changes known as atheroma and calcification.

(4) **The heart.**—Associated with arterial degeneration and the consequent increased difficulty in the circulation, and especially when to this an aneurismal dilatation of an artery is added, we have hypertrophy (rarely dilatation) of the heart. In cases, therefore, in which the diagnosis of aneurism is obscure the existence of cardiac hypertrophy, especially when no other cause for it, such as valvular disease, can be detected, the fact is in favour of the tumour being aneurismal.

(5) **Venous pulsation,** or pulsation in a vein, is observed in the rare cases of a direct communication between an artery and a vein, and is a very characteristic symptom. In the jugular veins it is also seen in cases of tricuspid regurgitation.

(6) **Venous engorgement,** as indicated by the dilated veins coursing over the part, or by its general lividity, is an important indication of an intimate connection of a swelling with the vascular system. It is well, however, to remember that the association may be entirely accidental, as in the case of a fatty tumour on the thigh and varicose veins of the leg; enquiry as to the time of appearance of the swelling and of the venous distension will generally be sufficient to eliminate this error. The direct connection of venous distension and swellings is fourfold. (*a*) *Venous distension may be the entire swelling.* In this case the swelling will have the outline of dilated, convoluted, and sacculated tubes, and will especially be characterised by being entirely compressible, unless the contained blood has at some spot or spots coagulated. (*b*) *The venous distension and the swelling may be produced by one common cause,* as *e.g.* obstructive or regurgitant heart disease; in this case the swelling is œdematous. (*c*) *The venous distension may be produced by the swelling obstructing the return of blood,* either by compression or obliteration of a vein or veins by the growth, or by a communication between an artery and a vein, the flow of the arterial blood into the vein impeding the venous return; examples of the former are seen in popliteal and other aneurisms, mediastinal and other growths, etc. In these cases the venous distension is on the distal side of the swelling, and may be accompanied by more or less œdema. (*d*) In other cases it is due to *increased blood supply necessitating enlargement of the efferent veins.* This is observed in very vascular growths, where the original calibre of the veins is not sufficient to carry off the great amount of blood conveyed to the part. In such cases the venous distension is noticed over and on the cardiac side of the swelling. As these growths may also obstruct the deep veins, some part of the venous

engorgement may be explained by this fact. These very vascular new growths are nearly always malignant, either sarcoma or carcinoma, and the blue veins coursing over a swelling are therefore of positive diagnostic value. Such veins are seen in some cases of chronic abscess, from destruction or compression of deeper veins.

XI. **Some tumours are reducible,** either wholly or in part, really or apparently. A tumour is *really* reduced when its contents are more or less completely emptied out of its capsule into one of the normal cavities of the bodies or into the vessels of the part. Examples of this are seen in hernia, some forms of hydrocele, varix, aneurism, and meningocele. A tumour is only *apparently* reduced when it disappears from its original position, but is not emptied out, and still remains of its original size. Examples of this we see in the reduction of hernia *en bloc,* in some cases of tumour of the spermatic cord, and of cryptorchismus, in psoas abscess, where the femoral pouch can be emptied into the abdominal, and in effusion into the bursa beneath the semimembranosus tendon, when this does not communicate with the knee joint. In the limbs the reducible contents of tumours are always fluid (blood, pus, synovia); in swellings in connection with the trunk the contents may be solid or fluid, as in hernia and varicocele. Reducible tumours are also subject to temporary increase of their usual bulk, and the conditions under which they become over full or emptied often aid materially in diagnosis. Position, pressure, and effort or strain, are the means usually employed to cause these variations in tumours.

(1) *Position.*—It is only the most easily reducible swellings, and particularly varices, that are affected by position. In the dependent position dilated veins, whether in the limbs or scrotum, fill out, and when

the part is raised, they at once empty themselves, either wholly or in part. This is, in a measure, due to the action of gravity, and also to the fact that the arterial blood supply to a part is increased by depressing it, and *vice versâ.* For this latter reason, aneurisms of the limbs become tenser and fuller when depressed. Some herniæ slip up and down, with alterations in the position of the patient.

It must be observed that œdema may be greatly modified by or only appear in the dependent position. When this is the case, the œdema is certainly passive. It is a well-ascertained fact that vaginal hydrocele may be fuller in the evening than in the morning, although entirely irreducible, the effect being due, it is supposed, to increased exudation during the day. In both these cases, however, the changes take place slowly.

Position has a still further influence upon tumours, due to the altered tension of muscles and fasciæ accompanying changes in position of the limbs. A typical illustration of this is seen in the case of effusion into the bursa between the tendon of the semimembranosus and the inner head of the gastrocnemius. When the knee is flexed, these muscles are lax, and the swelling partially or wholly disappears, the fluid bulging the sac towards the space of the ham; but when the knee is extended, these two muscles are tightly stretched and compressed one over the other; the fluid is driven from between them and distends the superficial part of the bursal sac, causing a prominent swelling behind the inner part of the knee.

(2) *Pressure.*—When exerting pressure we are enabled to judge of the amount of resistance to reduction, to note the manner of reduction, whether sudden or gradual, and any special accompaniments of the process. Venous tumours are always very rapidly *reduced by* pressure; other fluid tumours, such as

hydrocele and abscess, are steadily reducible, and whether rapidly or slowly depends upon the size of the aperture for reduction and the amount of resistance in the cavity into which they are reduced. If the contents of the tumour be fluid containing numerous small solid particles in suspension, a fine thrill, or sense of friction, is detected by the finger during reduction.

Solid tumours go back with an appreciably sudden motion recognised as a "slip ;" while the reduction of intestine is often accompanied by a gurgle. By the use of pressure, too, we are able to judge of the completeness or incompleteness of the reduction, as in the case of partially reducible hernia, or reducible hernia conjoined with an irreducible hydrocele. By following up the reduced swelling, we may generally ascertain with the finger the aperture through which reduction has taken place. Pressure is employed in yet another way, by making it circularly round a limb, or preferably to individual blood-vessels above or below a swelling, and noting its effect. Pressure on the cardiac side of a varix, unless so applied as to cut off the arterial supply to a part, causes the swelling to become fuller; whereas, if a varix be emptied and then pressure be applied to the vein below, it does not refill. Pressure on an artery feeding an aneurism causes a partial shrinking of the swelling, and if applied to the artery below the sac may lead to its increased tension; and further, when the artery leading to an aneurism is compressed, pressure upon the sac causes its reduction. (*See* pages 299 *et seq.*)

(3) *Effort* or strain causes distension of tumours which consist of the contents of the abdomen or thorax, and of those which are influenced by obstruction to the venous circulation. The production of, and especially the filling out, or impulse, in a hernia during effort, strain, or coughing, is one of its most characteristic symptoms ; a similar impulse is observed

in congenital hydrocele, in some tumours of the cord, in psoas and iliac abscess, and in pneumocele. The increased tension of tumours produced by the venous obstruction attendant upon straining efforts is particularly seen in venous nævi, varicocele, and in spinal or cranial meningocele and hernia cerebri, where the venous congestion in the spinal or cranial cavity presses out into the tumour more of the cerebro-spinal fluid. It is important to distinguish a true *impulse*, or filling out of a swelling, from a mere thrust forwards of a tumour or *displacement*. (*See* page 297.)

XII. **The pressure effects** of a tumour are always noteworthy, and they sometimes aid in the diagnosis. Reference has already been made to venous engorgement below aneurisms and other tumours compressing main veins. Neuralgic pains may be produced by similar compression of the popliteal or other sensory nerves, an interesting example of which is pain along the obturator nerve, felt in the knee, from the compression of the trunk of the nerve by an obturator hernia; here this symptom is of considerable diagnostic importance. Among other pressure effects of tumours must be mentioned muscular spasm and paralysis, of great importance when occurring in the larynx, and the gradual absorption of surrounding structures, even bone. They are of diagnostic value in indicating the position and relation of the swelling, as in the case of a popliteal aneurism, and also as showing the aggressive nature of a neoplasm, as in cases of tumours of bone.

XIII. **Concomitant affections** are frequently of special value in the diagnosis of tumours. This association may be twofold. Tumours may accompany other lesions produced by the same disease, both resulting from some common cause; the best examples of this are found in syphilis, where the existence of the characteristic ulcerations of the skin or mucous membranes, or of the tongue, nodes, necrosis of the bones of the nose or of the skull-cap, etc., greatly simplifies the diagnosis of a gumma. The association of exophthalmos with goître, and the coincident enlargement of many groups of glands, aids in the diagnosis of Graves' disease or of adénie; and the presence of tubercular disease of the lungs may simplify the diagnosis of a strumous testicle. In other cases, the tumours are secondary to the local affections; this association is still more common, and still more useful for purposes of diagnosis. As examples of this may be mentioned particularly glandular swellings, such as those in the groin from an abrasion on the foot, soft chancre, urethritis, soot-wart, epithelioma of penis; those in the axilla from inflammation or carcinoma of the mamma; those in the neck from pediculi capitis, otorrhœa, tonsillitis, facial chancre, epithelioma of lip, tongue, or larynx. Another example is furnished by the association of chronic epididymitis, or of perinæal abscess with stricture of the urethra.

XIV. **Puncture of the tumour,** with a view of removing some of the contents for examination, often determines its nature in cases which otherwise would be obscure. Where the tumour is supposed to be fluid, it may be tapped with a grooved needle, or a fine trocar and canula, and a syringe or aspirator may be attached to this with advantage. A grooved needle often suffices, but in deep collections of fluid, the solid tissues through which it passes may press into and block up the groove, and for this reason an exhausting syringe is much to be preferred. In the case of ulcers or ulcerated tumours, the surface should be cleaned and gently scraped with a clean knife, and the scraping so obtained may then be examined microscopically in a drop of glycerine or saline solution. Where the tumour is solid and not ulcerated, a harpoon may be introduced, by means of which a small fragment of the tissue can be removed, and examined microscopically.*

The fluid removed should be tested microscopically and chemically. In withdrawing fluid from any swelling, not only is the nature of the fluid to be investigated, but also its mode of escape, and the effect of its withdrawal upon the tumour.

Pus will be recognised by its colour and opacity, and by the presence of very numerous globular nucleated granular cells. It may be of the nature of thick pus, curdy pus, sero pus, etc. A peculiar penetrating and very offensive odour, quite *sui generis,* indicates that the pus is connected with *necrosed bone.* This odour is especially observed in connection with necrosis of the lower jaw and of the teeth. A *fæcal odour* indicates that the abscess has formed close to the alimentary canal, as around the cæcum or rectum. Where the abscess communicates with the bowel, the pus not only smells fæculent, but contains fæcal matter mixed with the pus. The pus from an *urinary abscess,* whether renal or urethral, may smell urinous, and show the characteristic test of urea. (*See* page 161.) A brown colour, when not attended with a fæcal odour, indicates an admixture of broken-down blood with the pus, as in a *suppurating hæmatoma.* The pus formed in connection with caries or necrosis of bone, when chemically examined, shows the presence of bone salts, even to the extent of 2 per cent.

Milk, when concentrated, may closely resemble pus. When allowed to stand a layer of cream rises to the top; under the microscope, the characteristic molecular basis, fat particles and globules, and large cells full of fat in fine division, are characteristic.

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* For the microscopical characters of the various tumours, the reader is referred to Pepper's "Manual of Surgical Pathology."

When mixed with pus, the smaller pus-cells are also present.

Blood is recognised by its colour, by the well-known red corpuscles it contains, by its spontaneous coagulability, and by its characteristic spectrum. By the rapidity with which it flows some estimate may be formed of the vascularity of the tissues pierced, and if it flow out forcibly and in a jetting stream, it is evident that an artery or an aneurism has been perforated; the colour of the blood may indicate whether the vessels opened are arterial or venous; the blood in the capillaries is bright in colour like that in the arteries. The escape of blood in any quantity indicates either that very vascular tissues, such as tissues acutely inflamed, soft sarcomata, carcinomata or nævi, or some larger blood-vessel has been punctured. If the tissues be acutely inflamed a drop of pus may be detected in the blood; if the needle or trocar have pierced a soft neoplasm some of its cells or distinct shreds of the growth may be recognised among the blood corpuscles.

Altered blood is recognised by its darker colour, sometimes brown, at others black; by its non-coagulability; by the corpuscles being converted into shrunken granuled *débris* (perhaps unrecognisable); and by the spectrum being that of methæmoglobin.* Such blood is obtained from old hæmatomata, hæmatoceles, and blood extravasations into tumours.

Where the *blood is withdrawn from the circulation* no alteration in the bulk of the tumour is produced, but when a *circumscribed collection of blood* is tapped some lessening of its bulk or tension may be noticed.

Cystic fluid varies greatly in its characters. It should be examined microscopically for any formed elements, such as cells, hooklets, hairs, spermatozoa, or crystals of cholesterine and fatty granules; and chemically for albumen, mucin, urea, chloride of sodium.*

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* *See* Ralfe's "Clinical Chemistry," page 77.

If the fluid be clear, free from formed elements, and the addition of silver nitrate to it show the presence of traces of chloride of sodium, while on boiling it gives but a slight precipitate of albumen, it is what is known as *serous fluid;* or the fluid from a *serous cyst.*

If the fluid be quite clear and watery, but become opalescent on standing, is alkaline in reaction, give no precipitate of albumen on acidulation and boiling, but a dense precipitate with nitrate of silver, it is probably *hydatid fluid,* and if the microscope reveal the presence of echinococcus hooklets in it, the diagnosis is certain.

If the fluid be clear or slightly turbid, viscid, and yield an abundant precipitate of mucin on the addition of acetic acid, it shows that it was obtained from a *mucous or synovial cavity,* and the position of the tumour will at once enable the surgeon to distinguish between these two.

Fluid removed from tumours of the head or back should be examined for sugar, by Fehling's, or some similar test, as the detection of sugar in such fluid would show it to be *cerebro-spinal* fluid, provided that the patient were not the subject of diabetes, when any of the fluids of the body may contain sugar. To examine a fluid for *urea,* nitric acid should be added to it, and the mixture evaporated, when crystals of nitrate of urea may be recognised under the microscope in the form of shining colourless rhombic plates.

If the fluid be turbid and contain shrunken epidermic scales, cholesterine crystals and granular fatty matter, it has been removed from a ***sebaceous***

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* For full details as regards these fluids the reader is referred to Ralfe's "Clinical Chemistry."

cyst. But if such a fluid be found acid in reaction, and hairs be seen in it, it shows the cyst to be a *dermoid cyst;* the contents of such cysts vary much; as a rule they are more fluid than those of sebaceous cysts.

If the fluid removed have the appearance of oil and solidify when cold, and again melt on the application of heat, and be entirely soluble in ether, it has been removed from an *oil cyst*, which is probably a variety of dermoid cyst. (For *Spermatic cysts, see* page 517.)

The withdrawal of a notable quantity of fluid from a tumour may cause its entire disappearance, showing it to be simply a collection of fluid; or it may cause a general and uniform diminution of the tension of the swelling, showing the tumour to consist of a single fluid-containing cavity; but if it lessen the tension or cause the collapse of one part only of the swelling, it shows that the collection of the fluid tapped is but a portion of the entire mass; the remainder may be of similar nature as in compound cystic tumours, or solid. Tapping a swelling may permit the detection and examination of parts of the tumour which were before inaccessible, as *e.g.* in tapping a hydrosarcocele, or when, after tapping an ascitic belly, cancerous masses in the omentum are felt. It is well, therefore, to remember the twofold object of exploratory puncture of tumours from a diagnostic point of view.

XV. **The age of the patient** is of importance in the diagnosis of tumours. In *infancy* we meet with congenital tumours of all kinds, such as nævi, dermoid cysts, cystic hygroma, spina bifida, meningocele,and encephalocele; swellings resulting from congenital malformations, such as hernia and hydrocele; swellings due to inherited syphilis or to rickets, and occasionally with fatty tumours and sarcomata. In *childhood and youth,* glandular enlargements, abscesses acute and chronic, and cartilaginous and bony tumours are most common. In *early adult life*, syphilitic and venereal affections, traumatic and inflammatory swellings, together with fatty, mucous, and fibrous tumours prevail. And *in late adult life*, malignant tumours of all kinds, and other senile swellings, such as those of rheumatoid arthritis and hydrocele become common. Age is of most direct value at the two extremes, in aiding the diagnosis of congenital tumours and of malignant tumours.

XVI. **Sex** seems to have little or nothing to do directly with the etiology, and therefore the diagnosis of tumours, apart from the affections of the organs peculiar to the two sexes. Aneurisms, with the exception of those of the carotid artery, and cancer of the lips and tongue, are much more frequent in men than women, but this is probably not due primarily to sexual difference. A case in point, however, is afforded by the much greater prevalence of femoral hernia in women than in men.

XVII. **The previous history** of the patient may aid in the diagnosis of tumours. In diathetic diseases such as struma and syphilis, evidence may thus be obtained of the existence of those diatheses. In the infective diseases, such as sarcoma and carcinoma, light may be thrown upon the nature of a secondary tumour arising after the removal of the primary focus of disease; thus, where a cancerous tongue has been excised, a progressively enlarging gland in the neck will not be mistaken for a strumous gland or some other simple tumour.

CHAPTER XVI.

DIAGNOSIS OF GENERAL TUMOURS.

HAVING in other chapters treated of the diagnosis of fluctuating and pulsating swellings, of swellings connected with bone, and of swellings of special regions, it remains for us here to speak of those swellings which have not these particular features, and which occur more or less generally over the body. In investigating such tumours, the first point to be determined will be the *history* of the growth, especially whether *congenital* or *acquired;* if the latter, whether *traumatic* or *idiopathic*; and if idiopathic, whether accompanied by signs of *inflammation* or not; in any case, whether it is *stationary, continuously progressive*, or *receding.*

Then the surgeon should examine the swelling, and first of all notice *to what structures* it is *adherent* (skin, superficial fascia, muscle, gland) and its degree of adhesion to or mobility in these; whether it have a sharply marked *outline*—and if so, the character of its edge—or gradually fades off into the healthy parts around. Then observe its *consistence*, whether hard, firm, soft, or gelatinous, whether *compressible* or not, and if it fill out and become more tense on strong expiratory efforts, and particularly whether the surface be *smooth* or *lobulated* at any part; in some cases the colour of the swelling is characteristic. If the skin be ulcerated over the tumour, the characters of the ulcer will of course attract attention. Then the surgeon should feel the lymphatic glands *connected* with the swelled part, and notice whether they are enlarged or not. Lastly, evidence of constitutional diathesis (syphilis, struma) should be carefully sought for. The bearing of many of these facts upon diagnosis has been already discussed, but we may here add something to what has been previously said.

(*a*) It must be borne in mind that congenital tumours may not be noticed until some time after birth: this is not infrequently the case in very small dermoid cysts. Similarly, it is not infrequent to find that some trivial injury has called attention to a swelling or a lump, which, from not being painful or conspicuous, had previously escaped notice, and which the patient may be inclined to consider as actually caused by the injury. Inflammation may be the exciting cause, or may accompany a swelling from its first commencement, but in other cases it comes on later, and as a secondary condition; this is particularly seen in such cases as sloughing gumma, cystic hygroma (where repeated attacks of superficial inflammation are very characteristic phenomena), and in large sebaceous cysts.

(*b*) Inflammatory growths, gummata, and malignant tumours tend to infiltration in their growth, and to involve rather than to displace surrounding tissues, while the benign tumours displace tissues, and are encapsuled. The degree of mobility of tumours varies much, and it is important to notice the direction of mobility, and also what may be called its character. As already pointed out, neuromata and some tumours connected with vessels, have free mobility in one direction only (across the nerve or vessel) and none in the other. By the character of mobility is meant whether it is a mobility of the entire part, or of the tumour in the tissues amid which it is growing; a cancerous tumour of the breast, for example, may be freely movable with the mamma over *the chest*, but careful examination will show it to be quite immovable in the breast itself. Some fatty tumours show the greatest freedom of mobility, and the way in which the smooth rounded edge of these growths slips from under the finger is quite characteristic. The most noteworthy feature of the outline of tumours is the characteristic lobulation of fatty tumours; the lobules are ovoid or rounded, and somewhat loosely adherent one to another; this sign is pathognomonic of fatty tissue.

(*c*) In regard to the lymphatic glands it is to be remembered that they may be enlarged from causes other than the tumour; but excluding these, the glands may be enlarged by inflammatory swelling, or by a secondary growth of the actual tumour tissue; in the early stage it is quite impossible to distinguish between them; but progressive and then infiltrating growth indicates secondary infection of the glands.

The surgeon should first notice whether the swelling be reducible or yield under compression, and then fill out again when the force is removed; excluding fluctuating and pulsating tumours giving this sign, we have *nævus* and *hernia.* The signs of hernia are fully discussed in chapter xxxv., and we need not repeat them here.

Nævus is a congenital formation, or appears soon after birth; it may be stationary, or grow with various degrees of rapidity, or undergo spontaneous recession and cure; very commonly the diagnosis is rendered very easy by the nævoid condition of the skin, at other times the blue colour of the tumour is visible through the thin skin. Although these swellings are largely fluid, they do not fluctuate, and as they are connected with veins they do not pulsate. They may be met with in any region of the body. Under compression they yield gradually (not suddenly) and without any gurgle or slip, as is common in hernia, and they at once fill out again when the force is removed, and become especially full and tense under any effort or strong expiration.

Then the surgeon should ask himself whether the swelling is connected with any of the special structures of the part, *veins, nerves*, or *lymphatic glands*, and for this he must look to its position, connections, and outline.

1. If the swelling be elongated, cylindrical in shape, and in the course and position of a vein, it is a *thrombus*. If the swelling have recently appeared, and is painful and tender, it is a *recent thrombus*. While if to these signs there be added an ill-defined outline of the swelling, obscuring its original form, and pyrexia, there is also *phlebitis* and *periphlebitis*, which may run on to *suppuration;* if the swelling be chronic, painless and of stony hardness, it may be recognised as a *phlebolith*. In the acute conditions there is generally more or less œdema of the parts returning their blood through the occluded vein, but this largely depends upon the site of the obstruction. In the case of superficial veins the diagnosis will rest upon the character of the swelling; in thrombosis of deep veins it rests rather upon the occurrence of local œdema, with pain and tenderness along a vein; for often the actual swelling of the vessel and its outline cannot be made out, and owing to the danger of detaching a portion of the clot, only the gentlest manipulation is warranted,

2. If the tumour be situated in the course of a nerve, is firm, clearly outlined, globular, or ovoid in form, with its long axis parallel to the axis of the limb, movable transversely, but immovable vertically; and, further, if there be pain of a neuralgic character along the terminal branches of the nerve in question, sometimes coming on in violent paroxysms, or excited by pressure upon the swelling, it may be recognised as a *neuroma*. These tumours vary much in size and

consistence, and they are often multiple, affecting one or several nerves. They may be met with on the ends of nerves in stumps or scars.

3. If the swelling occur in the site of lymphatic glands, and have the ovoid or globular outline of these bodies, and especially if it be multiple, and movable under the skin and over the neighbouring deeper parts, and there be some obvious exciting cause, it may be diagnosed as *lymphatic glandular.* It is only in quite a few regions that there is any difficulty in arriving at a correct diagnosis, and these cases are discussed in other chapters. Having determined that the swelling is glandular, the surgeon must next proceed to determine its cause, or the variety of glandular enlargement he has before him.

(*a*) If the swelling be acute, following an injury or an inflammation of some part pouring its lymph into the affected gland, and the gland be painful, tender, more or less fixed in the surrounding tissue, and especially if the skin over it be red and œdematous, it is *inflammatory.*

(*b*) If the enlargement be chronic, slowly progressing from gland to gland, forming firm, painless, rounded swellings, which exhibit a tendency to slow disintegration, and especially if it occur in the neck, and there are scars of old abscesses in the neighbourhood, or thin unhealthy scars of ulcers, or other signs of the strumous cachexia, such as disease of the bones or joints, ulcer of the cornea, strumous lip, etc., and the dull complexion and pallid anæmic state so common in these cases, the condition is to be regarded as *strumous.*

(*c*) If the affected glands are multiple, firm, freely movable in the connective tissue around, not painful or tender, and if the glandular swelling be accompanied by other signs of constitutional syphilis, they *are to be regarded as syphilitic.* In the groin or in other regions where they are associated with a sore which may be a hard chancre, it is the fact that there are many glands enlarged (in both groins), that they are hard and shotty, not blended together into one ill-defined mass, that they do not exhibit a tendency to suppurate, that they are accompanied or followed by the usual manifestations of secondary syphilis, and that they yield to antisyphilitic treatment, which renders the diagnosis certain. But they occur in syphilis quite apart from primary sore, especially in the posterior triangle of the neck and above the internal condyle of the humerus, and the swellings there have the same general characters which, with the accompanying signs of syphilis (rash, sore throat), make the diagnosis clear.

(*d*) If the glandular swelling progressively increase, spread from gland to gland, infiltrate the neighbouring tissues, involving the skin, muscle, etc., and if there be or have been a malignant tumour in the neighbouring parts, it is *malignant* in its nature; these infective malignant growths are most often carcinomatous, but they may be sarcomatous, and in all cases they are of the same nature as the primary tumour.

(*e*) If the glandular swelling be a primary and chronic growth, affecting many glands and many groups of glands, forming large, rounded, lobulated masses, inconvenient only by their size, steadily and persistently growing, but not showing any tendency to soften or suppurate, and if with that there be progressive debility and anæmia, and especially if the spleen be at the same time enlarged, the disease is *lymphadenoma*. The blood should be examined, and if there be a great increase of white corpuscles, the disease is *leucocythæmia*, while if there be no notable increase in these cells, it is *pseudo-leucocythæmia* or *Hodgkin's disease*. The cervical glands are those most often and first affected, and the disease may remain limited to them for some time, and then suddenly spread to other groups of glands, causing rapid enlargement. When removed the glands are not found to have undergone fatty or caseous degeneration.

4. Some of the remaining tumours may be at once separated as **congenital,** and if the tumour be irregular in outline, very soft and loose, but incompressible, with parts that fluctuate and others that are solid, and especially if there have been repeated attacks of inflammation of the skin over it, it is a *cystic hygroma.* These tumours are most common in the neck, axilla, and groin, are often multiple, and may attain a large size.

5. But if the tumour be wholly solid, soft, and incompressible, and its surface or edge be felt to be lobulated, it may be diagnosed as a *lipoma.* The congenital fatty tumours may be placed deeply under muscles, and may be attached to or involve muscles, or even be attached to bone; and hence they are not so freely movable as the acquired tumours in the subcutaneous tissue. Their lobulation, however, is just as characteristic. If the tumour be soft, it may yield a sensation so like fluctuation that puncture may be required to show whether it is solid or fluid.

6. Of the **acquired tumours** there are certain forms that may be easily recognised by certain well-marked characters.

(*a*) If the tumour be an outgrowth from the skin, entirely raised above its surface, and therefore clearly marked off at its attached base; firm, dry, and hard (unless in a situation where it is kept moist by secretion), granular or branched on the surface, it is a *wart* or *papilloma.* These vary much in appearance, according to whether the branching processes of which they are composed are more or less blended together, and according to the density of their tissue.

(*b*) If the tumour be fixed to and infiltrate the skin, and spread both laterally and deeply, be firm, ulcerated on the surface, the ulcer having thick everted edges and an irregular granular base, a serous discharge, and if the lymphatic glands of the part be enlarged, hard, and progressively increasing in size, it is an *epithelioma*. A scraping from the ulcer will show under the microscope large and irregular epithelial cells with large clear nuclei, and possibly also parts of epithelial "nests." (For diagnosis between epithelioma and chancre *see* page 336.)

(*c*) If the tumour be a small nodule raised above the surface, globular or ovoid in shape, of a glistening white colour like white wax, umbilicated in the centre, firm and fixed in the skin, it is *molluscum contagiosum.* These tumours may be single or multiple, and they are most common on exposed parts of the body.

(*d*) If the tumour take the form of a pedunculated pendulous outgrowth of the skin, soft, elastic, and smooth, it is called *molluscum fibrosum.* When of large size, or exposed to friction, these growths may ulcerate on the surface.

(*e*) But when the swelling is in the form of pendulous folds of firm thickened skin and subcutaneous tissue hanging from the buttock, back, shoulders, and thighs, while sometimes called by the same name as the pedunculated variety described above, it is better known as *diffuse fibroma.* Both forms are very chronic in their course, and do not recur upon complete removal.

(*f*) If the tumour be ovoid or rounded in shape, lobulated on the surface, with a shallow rounded edge, and be freely movable in the subcutaneous tissue, but slightly connected with the skin as shown by its dimpling over it when the tumour is compressed, it is a *lipoma.* These growths are most common on the posterior part of the body, and about the shoulders and waist. They are not unfrequently multiple, and may be very numerous; they vary in size within very wide limits, and are usually painless, and often remain stationary for years. They have been known to change their position, moving downwards. If the swelling be soft, granular, or lobulated, adherent to the skin, but without a distinct edge, movable over the deeper parts, but not movable in the subcutaneous fascia, it is a *diffuse lipoma*, which is most common as "double-chin," or at the back of the neck, or in the belly-wall. The feature by which fatty tumours are to be recognised with most confidence is the soft lobulation of their surface, which is eminently characteristic.

(*g*) If the tumour be of chronic course, of very slow growth, or perhaps have remained stationary for some time, rounded in outline, smooth or lobulated, firm, adherent to the tissue from which it grows—whether skin or fascia, but freely movable over the surrounding parts—it may be recognised as a *fibroma*. Many neuromata are of this nature, and are distinguished from similar growths unconnected with nerves, by their peculiar kind of mobility and by the character of the pain associated with them.

(*h*) If the tumour be of recent growth, of ill-defined outline, immovable in the tissue in which it is placed, and having a tendency to infiltrate neighbouring tissues, involving, perhaps, skin, fascia, and muscle, and especially if the growth slough, or soften at one or more places, leaving a sloughy sinus or ulcer, it is a *gumma*. Evidence of other syphilitic affections past or present, and the disappearance of the tumour under antisyphilitic treatment, will materially support and confirm the diagnosis. The absence of a sharply-defined outline, the thin, flattened, or ovoid, and not globular shape, and the evidently infiltrating mode of growth, together with a somewhat rapid formation compared with other chronic tumours, will usually lead to a correct diagnosis.

(*i*) Similar swellings affecting the skin alone, or the skin and subcutaneous tissue, occurring in children and young people, and quickly breaking down into fluctuating collections of thin pus, are *scrofulides*. They are usually, but not always, multiple, and the various swellings may show their different stages. The patient may or may not show other distinct signs of the scrofulous diathesis.

(*j*) If a tumour have grown steadily and rapidly, and be found immovable in the part from which it has grown, and still more, if it have spread to and infiltrated neighbouring parts, such as skin and muscles, and if there be progressive enlargement of the neighbouring lymphatic glands, or secondary growths can be detected in the lungs, liver, or other organs ; or if after apparently complete removal the tumour have recurred in or close to the cicatrix, it may be recognised as a *malignant tumour*. These tumours vary much in their characters and in their degree of "malignancy." In some it is only after removal and microscopical examination that their true nature is known, while in others their "malignancy" is unmistakable. They sometimes show other signs more or less characteristic, such as ulceration and fungating growth, softening and cyst formation. While met with at all ages, they are decidedly more common after thirty-five years of age. In some cases the influence of heredity seems to be very marked; but in no case should it be relied upon to any extent for purposes of diagnosis, while no weight whatever is to be attached to the absence of such a history. The much-spoken-of "cancerous cachexia" is purely the result of the pain and exhaustion caused by the tumour, or of its direct or mechanical interference with nutrition, and is therefore *of no value* for diagnosis.

The signs upon which reliance is to be placed are: (α) the infiltrating mode of growth; (β) the persistent enlargement of the tumour in spite of any palliative treatment (there are a few exceptions to this in some instances of "withering" scirrhus); (γ) the spread to neighbouring tissues; (δ) the formation of secondary growths in the lymph glands or other parts; and (ε) the local recurrence after removal. In some cases there are certain special signs, such as the retraction of the nipple in a mammary scirrhus, and pulsation in sarcoma of bone.

To distinguish between *sarcoma* and *carcinoma*, the recognition of the tissue in which the neoplasm started will be of great value, as it is generally held that sarcomata originate only in tissues of the connective-tissue type, and that carcinomata spring only from tissues of the epithelial type. Where these tissues are intimately blended together, as in the breast, this test cannot be applied, and we have to rely upon other signs, but in such cases as the skin, muscle and fascia, it is a test of extreme importance and value.

The infection of lymph glands is another important sign, for while this does occur in sarcomata, it is much more common in carcinomata, although Mr. Butlin has shown that the site of the malignant growth plays a large part in determining the infection of the lymphatics. Age is another factor which may be of value, for while carcinomata are essentially tumours of middle and later life, sarcomata are met with at all ages, although becoming more common in later life.

To distinguish between the varieties of sarcoma may be quite impossible without the aid of the microscope; but the firmer and slower the growth of a tumour, the more likely is it to be formed in part of *fibrous tissue* and of *spindle* cells, while the round *cell sarcomata* are softer and of more rapid growth. A black colour of the growth will of course indicate a *melanotic* sarcoma. In some very soft and very vascular sarcomata hæmorrhage into the growth may occur, and either before or during operation the surgeon may mistake them for *blood cysts*; an examination of the wall of the supposed cyst, and noticing the fact that the swelling does not collapse when tapped, will guard against this error.

The great hardness of some forms of carcinoma, together with signs of contraction of the growth, will enable the surgeon to recognise *scirrhus*; while in softness of tissue, rapid growth, and globular outline, he will see evidence of *encephaloid*. When the cancer attacks an epithelial surface and rapidly ulcerates, it is an *epithelioma*.

CHAPTER XVII.

THE DIAGNOSIS OF FLUID OR FLUCTUATING SWELLINGS.

THE detection of fluctuation in a swelling merely indicates its fluid nature, it tells us nothing with regard to the character of the fluid contents, but nevertheless the sign forms a very useful and practical starting-point for the diagnosis of a large class of swellings, which we will now consider. The fluids met with in such swellings are blood, inflammatory effusions (serous, synovial, or purulent), cystic fluids of all kinds, dropsical effusion, and more rarely urine and bile.

The first step in the diagnosis is to distinguish between the swellings which have arisen acutely and *those which* are chronic in their nature.

A. **Acute fluctuating swellings.**

Hæmatoma.
Serous or synovial effusion.
Acute abscess.
Distended bladder.

Notice whether the swelling arose spontaneously, or as the result of an injury; whether it formed suddenly, or more gradually and progressively; whether accompanied by any signs of bruising or ecchymosis; whether attended with signs of inflammation, and, if so, whether these preceded the marked swelling, or *vice versâ;* the precise outline of the swelling, whether it corresponds with that of a serous or synovial cavity or the urinary bladder; whether it is in the position of a lymphatic gland.

If the swelling have arisen suddenly, and have immediately followed a blow, or strain, especially if there be any bruising of the surface, and there be an absence of all evidence of inflammation, or, if present, the inflammation have followed upon the swelling, the diagnosis of *hæmatoma* is to be made. (*See* page 27.)

If the swelling correspond in position and outline to a serous or synovial sac, and have formed with signs of inflammation (pain, tenderness, heat, perhaps redness, and pyrexia), it is *serous or synovial effusion.* And if the swelling progressively increase with deepening redness of the skin, superficial œdema, increased pain, tenderness and local heat, and especially if the fever rise to a high point, or rigors with sweatings occur, the fluid may be considered to have become purulent, or the case to be one of a *serous or synovial abscess.*

If the fluctuation be detected in a swelling which is attended with redness, local heat, pain, tenderness, and pyrexia, and especially if it be known that these signs of inflammation preceded the existence of fluctuation, the diagnosis of an *acute abscess* is to be made. Local *œdema* is a valuable aid in some cases, as it greatly strengthens the evidence in favour of the presence of pus.

If the swelling be situated immediately above the pubes, and correspond in outline with the urinary bladder; especially if it be also detected bulging down against the rectum, with fluctuation between the two parts of it, and there be a history of the patient not having passed urine for many hours, the diagnosis of a *distended urinary bladder* is to be made, and this will be completely established if on passing a catheter and drawing off the urine the swelling disappear.

B. Chronic fluctuating swellings.

Hæmatoma.
Serous effusion.
Chronic abscess.
Cyst.
Aneurism.
Varix.
Distended urinary or gall-bladder.

As an *hæmatoma* may last for some time, even for months, unchanged, it must be included among chronic as well as acute swellings. In investigating these chronic fluctuating tumours, the surgeon should first inquire into their history, and especially with the view of eliciting a history of injury or of inflammation; he should then carefully notice whether there be at the time of examination any evidence of inflammation in the swelling, or in any of the neighbouring parts, especially the bones and joints; whether the swelling correspond in position and outline to a serous or synovial cavity, or the sheath of a muscle; whether it be adherent to a vessel or a gland, or occupy the site of a vessel or a gland; whether it be influenced by the surrounding fascia or not; its outline, whether globular or more flattened; whether adherent to the parts around, and if so in what directions it is movable; whether the swelling fluctuate throughout; or whether part be solid, and *if separate* fluctuating areas can be detected in it.

In some cases puncture of the swelling, or special signs, such as retention of urine, and the effects of catheterism may be necessary to clear up the diagnosis.

If the swelling immediately followed upon an injury or strain, particularly if it were attended with superficial bruising, but not with the signs of inflammation, and is more or less globular in outline, it may be diagnosed as an *hæmatoma*. (For Cephalhæmatoma *see* page 77 ; for Hæmatocele *see* page 509.) The softening of the tissues around an inflammatory effusion is not met with in hæmatoma and cysts, and this accounts for the more globular outline of hæmatomata and cysts as compared with abscesses.

If the fluid tumour be in the position and of the shape of a serous or synovial membrane, bursa, or sheath of a tendon, or a hernial sac, it is to be recognised as a *serous* or *synovial effusion*. As examples of this may be cited housemaid's knee, miner's elbow, palmar ganglion, dropsy of the knee, and vaginal hydrocele.

If there are no signs of inflammation of the part (heat, pain, redness, tenderness), and no history of such, and if the neighbouring parts, as the bones and joints, are free from disease, and if the tumour be of a globular shape, with distinct outline, movable over surrounding parts, and especially if it be tense, projecting from the surface, and not affected in its direction of growth by the muscles or fascia, it is to be diagnosed as a *cyst*. Where such cysts are met with in connection with glands, they may be *retention cysts*, as ranula, some cysts of the mamma, and the common sebaceous cysts of the skin. When occurring in the planes of cellular tissue unconnected with glands, and especially if they are found lax, with thin walls, and (if the test can be applied) translucent, they are what are known as *serous* or *lymphatic* cysts, and are sometimes spoken of as *hydroceles.* These cysts are congenital. (*See* page 285.)

When they are found over joints or synovial sheaths, when they are tense, firm, and fixed to the deeper structures, from which they cannot be entirely separated, they are to be recognised as *synovial cysts*, *e.g.* the common ganglion of the back of the wrist. Similar cysts are met with in connection with the larger joints, as the knee and the elbow, and they may be quite superficial, and have a long and very narrow pedicle leading down to the articulation; but the surgeon must be on his guard to recognise their true nature, or he may be led to open an articulation unawares. The peculiar tenseness of these cysts, their mobility under the skin but their fixity on their deep aspect, are the points on which a diagnosis may be made to rest. The author recently met with one of these cysts some inches below the knee.

Where there is a history of congenital origin, or where the tumours are noticed in early childhood and such an origin is therefore probable, especially when occurring under the occipito-frontalis or orbicularis palpebrarum, they may be diagnosed as *dermoid cysts.* These cysts are met with in every part of the body, but especially on the head and face, and in connection with the ovary. When opened, the peculiar nature of their contents (hair, teeth, pieces of bone, etc.) and the structure of their walls establishes the diagnosis.

Where a swelling is found to be in some places solid, and in other places fluctuating, or where two or more distinct fluctuating areas are found in the same tumour, the disease must be recognised as a *cystic tumour* or *compound cyst.*

If there have previously been, or are at the time the patient is examined, any signs of inflammation of the part, especially pain, tenderness, or redness of the skin, or if there are any signs of inflammation of neighbouring or connected parts, particularly bones and joints, a chronic fluctuating swelling may be recognised as a *chronic abscess.* Examples of such are constantly met with in abscesses round diseased joints, psoas abscess, and many cases of strumous cervical abscess. If from the position and outline of the swelling it be evident that the fluid is contained within the sheath of a muscle, or has travelled along a plane of cellular tissue, and has been governed in its direction of growth by the surrounding muscles and fasciæ, even in the absence of the above signs, the same diagnosis may be made. A third sign by which chronic abscesses may be recognised is their origin in solid swellings which undergo softening. For instance, when a strumous child presents two or more small firm swellings of the skin and subcutaneous tissue, if the surgeon find one of the smallest of the swellings firm and solid, and the larger and older ones fluctuating, he may be certain that he has to deal with chronic abscess, the common *scrofulide.* As a rule, chronic abscesses are less tense than cysts, though exceptions are met with, and their outline is not so characteristically globular; they are always adherent to the tissue immediately surrounding them. In this particular, the distinction between a sebaceous cyst adherent to the skin in the centre only and a scrofulide adherent to and involving the skin over its whole surface, is very marked.

When the fluctuating swelling occurs over and adherent to a main artery, and exhibits an expansile pulsation, etc., it is an *aneurism.* (*See* Pulsating Tumours, page 296 *et seq.*)

If the swelling be met with in the course of a vein, and is elongated in the direction of a vein, cylindrical in shape, compressible, and completely emptied by raising the part or by pressure, and especially if a blue colour be seen through the skin, or other superficial veins are seen coursing towards it, the diagnosis of *varix* is to be made.

It is only rarely that the nature of this affection is not at once apparent. The case in which any difficulty of diagnosis is met with is that of a saccular pouching of the saphena vein close to the saphenous opening. (*See* page 530.)

The signs of a *distended urinary bladder* are the same, whether acute or chronic, except that the pain and tenderness are much more marked in the former case. (*See* page 292.)

If the swelling be found occupying the right hypochondrium, reaching up under the ribs, rounded in outline, not adherent to the abdominal-wall, and if there be a history of gall-stones or of attacks of pain with jaundice, the diagnosis of a *dilated gall-bladder* may be made.

CHAPTER XVIII.

THE DIAGNOSIS OF PULSATING SWELLINGS.

THERE is no problem of greater importance to the surgeon than the correct diagnosis of a pulsating tumour; in most instances its solution is easy if only care be taken, but from time to time cases present themselves which test to the utmost diagnostic skill and knowledge, if indeed a diagnosis be possible at all. The point upon which it is necessary to insist, first of all, is the necessity of not relying upon any single symptom, but of making a careful and complete examination of the case, and of weighing all the signs. The tumours which pulsate may be thus enumerated:

Fusiform aneurism.
Sacculated aneurism.
Varicose aneurism.
Cirsoid aneurism.
Aneurismal varix.
"Pulsating tumour."
Encephalocele.
Tumours over arteries, including abscess, cyst, and solid tumours.
Ruptured artery or ruptured aneurism.
Tumours situated over aneurisms, especially abscess.

The most important point to be determined in every such case is whether there be an aneurism present or not; and then if an aneurism be present, whether the entire tumour be aneurismal. We will first refer to the examination that should be made, pointing out the bearing upon the diagnosis of each fact elicited, and then, putting these together, will mention the distinguishing features of each of the pulsating swellings.

1. **Notice the position** of the swelling; whether it corresponds to the known course of an artery of large or medium size, or whether far removed from such. Fusiform and sacculated aneurisms, and tumours with communicated pulsation are only found over arteries of some size. Cirsoid aneurism and "pulsating tumours" may occur in these situations, but also quite removed from main arteries, *e.g.* a pulsating swelling in the ham may be an aneurism, a "pulsating tumour," or a tumour with communicated pulsation; a similar swelling on the outer side of the lower end of the femur can only be a "pulsating tumour," or a cirsoid aneurism.

2. **Feel the pulsation** and determine (*a*) whether the tumour is filled out at each beat of the heart, and is expanded in all its diameters, or whether it is simply thrust forwards. For this purpose, place a finger of each hand on opposite sides of the swelling, and notice whether they are thrust apart by the impulse or are simply raised; or the same thing may sometimes be plainly demonstrated by fixing a piece of strapping with a slit in its middle over the swelling, when, if the impulse be expansile, the slit will open out with each beat of the heart. An *expansile impulse* is caused by the forcing of more blood into the swelling, and is therefore a sign common to aneurisms of all kinds, aneurismal varix and "pulsating tumours" which are so vascular that the change of tension of their numerous vessels affects

the entire mass. A non-expansile or a *heaving impulse* shows that it is communicated, and not intrinsic. Should an aneurism become shut off from the artery which remains pervious, its pulsation, which was formerly expansile, would become heaving.

(*b*) Notice whether the pulsation is felt as a wave passing through the swelling, or is simultaneous in every part; the former is characteristic of aneurism, the latter of "pulsating tumour;" too much reliance must not be placed upon this sign, and it is of positive rather than of negative value.

(*c*) Then examine to see *if the pulsation be uniform* throughout the whole swelling; this is usually the case in aneurism. If the pulse be only or mainly felt along the line of the artery, and not in the lateral expansions of the swelling, it indicates that the tumour is lying over the artery, and not communicating with it; while if the pulsation be felt in parts of the swelling only, but these parts do not correspond with the line of the artery, it would be strong evidence in favour of the swelling being a "pulsating tumour," as it often happens that only parts of these tumours present this sign.

(*d*) Lastly, notice whether the *pulsation can be abolished* in the swelling by any manipulation which does not interfere with the circulation in the main vessel, such as lateral or vertical movement of the swelling, or, if the swelling be in the abdomen, turning the patient on his hands and knees with the belly-wall lax, and allowing the tumour to fall away from the aorta. The pulsation in an aneurism or "pulsating tumour" is quite unaffected by the position of the part; that in a case of communicated pulse may be greatly altered by changes in its position which vary the pressure with which it rests upon the artery; and it may therefore be asserted that whenever, in any *particular position* of the parts, the tumour loses its pulsation while the flow of blood through the artery, as shown by the pulse below, is not stopped, it is demonstrative proof that it is a case of communicated or extrinsic impulse only.

3. **Compress the main artery of the limb above the swelling.**—This will in every case stop the pulsation, and by itself tells us nothing. But now notice (*a*) whether the *swelling spontaneously collapses ;* if so it plainly indicates a free communication between the artery and the swelling.

(*b*) Then compress the tumour, and notice if and to what extent it *yields to the pressure.* Compressibility (or reducibility) of a tumour shows that the tumour is partly fluid, and that it communicates with a vessel or some other cavity; such a tumour may be an aneurism, aneurismal varix, pulsating synovial cyst (if near a joint), or meningo-encephalocele (if in connection with the head); the amount of the tumour that is irreducible will form a guide to the amount of solid matter in the tumour, whether blood-clot or brain; if the tumour be entirely unyielding to pressure or wholly irreducible, it may still be an aneurism nearly or wholly solidified, or a "pulsating tumour," or a tumour with communicated pulsation not opening into a cavity.

(*c*) Then remove the compression from the artery, and notice how the *pulsation returns* in the swelling. If the tumour be again filled out in two or three strong bounding beats it indicates an escape of blood from the vessel into a partially empty cavity, such as an aneurismal sac. If, on the other hand, the pulsation at once returns as before, gently, without forcible bounds, and simultaneously over the whole swelling, it indicates that it is due solely to the movement of blood in the arteries, and that the pulsation is either communicated or that of a "pulsating tumour." It is to be remembered that in the cases of aneurism which are not compressible pulsation may return at once with its usual force. Should the tumour be reduced by pressure but return to its normal size while the compression of the artery is still kept up, it shows that the swelling is not an aneurism; this may be observed in cases of reducible pulsating synovial cysts. Some cases of encephalocele have an impulse and are partially reducible within the cranial cavity, the pulsation becoming more marked as the reduction is accomplished.

4. **Compress the artery beyond the swelling,** and if an aneurism, its size and tension will be to some extent increased; a "pulsating tumour" will be unaffected by such pressure.

5. Examine carefully in all these cases to determine whether there is any **mobility of the swelling apart from the neighbouring artery.** Arteries admit of a limited amount of lateral movement, but of none in their length, and therefore having relaxed as far as possible all the fasciæ and muscles of the region, the surgeon should try whether the swelling under consideration is movable in the line of the artery. When this mobility is present it is very strong evidence of the pulsation being communicated; on the other hand, some swellings with communicated impulse are quite immovable, *e.g.* abscesses over arteries. "Pulsating tumours" are immovable because of their growth from bone. As examples of the great diagnostic value of this sign may be mentioned the rise and fall of a thyroid swelling during deglutition, which absolutely distinguishes it from a carotid aneurism, and the mobility of enlarged glands in the ham when the knee is flexed; some abdominal tumours may be moved from over an artery, and so lose their pulsation.

6. **Attempt to reduce by compression** the *swelling without* compression of the main artery above.

This manipulation, like all the others, must be carried out with great gentleness and care. If successful it shows that the reduced part of the swelling is not an aneurism, and also that it is fluid, and further, that it communicates with a cavity such as the cranium or a joint. By this sign, then, we can diagnose a synovial cyst communicating with the knee-joint and with communicated pulsation, from a popliteal aneurism, or an encephalocele from a "pulsating tumour" of the cranium. Part of a pulsating swelling may be thus reducible in the case of two tumours of different nature blended into one swelling.

7. Examine for a bruit and a thrill, feel the pulse beyond the swelling, and the outline of the swelling whether defined or not; examine the condition of the superficial arteries and the heart (*see* page 265), and enquire carefully into the history of the affection.

It is necessary to remind the surgeon that all manipulations of an aneurismal tumour should be conducted with the utmost gentleness and care, and that when once the diagnosis of an aneurism has been made no further manipulations of the part are justifiable; it is not intended that all the above procedures are to be gone through in every case of pulsating swelling. The surgeon has to answer the question, Is the swelling an aneurism? and it is only when that question cannot be at once answered in the affirmative that such varied and prolonged manipulations are necessary to clear up the diagnosis.

It may be well to state here that an *aneurism may lose its pulsation* (a) from solidification of its contents, (b) from occlusion of the mouth of the sac by coagulum, (c) by compression of the artery above by the sac, (d) or by its rupture and diffusion, which may take place slowly, the blood clotting in the tissues, or rapidly and even suddenly, the blood infiltrating the tissues far and wide.

We will now briefly describe the diagnostic signs of the individual pulsating swellings.

1. If, in a person with signs of general arterial degeneration, an elongated pulsating swelling be found in the position of one of the large arteries, which tapers at each end into the artery, and the pulsation in which diminishes towards each end and has only a slight lateral extent, it is a *fusiform aneurism*.

2. An irregular compressible swelling, obviously formed of tortuous and sacculated tubes, with marked expansile pulsation, and loud systolic bruit, is a *cirsoid aneurism*. This affection is most common in the scalp and the hands, though it may occur in deeper situations, as the orbit and iliac fossa. Sometimes congenital, it is more common before than after thirty years of age. As it grows it extends superficially, and does not exhibit a tendency to form a globular tumour. The skin covering the swelling is hotter than the surrounding skin; it may be thickened, but is often thinned, inflamed or ulcerated. The arteries leading to the swelling are often found dilated and tortuous.

3. If the vein or veins of a part be found greatly dilated, with expansile pulsation, well-marked thrill, and a loud rasping or hissing continuous murmur, increased in intensity at each cardiac systole, this murmur being conducted along the veins for some distance, it is an *aneurismal varix*. If, in addition to these signs, there be a more or less distinct tumour at the spot where the murmur is most intense, fixed to, but distinct from, the artery and vein, with expansile pulsation, compressible, it is a *varicose aneurism*. These diseases generally follow an injury, though at an interval of many years. The bruit is not uncommonly so loud as to be audible to the patient, and sometimes even to bystanders. The two affections are also known as *arterio-venous aneurism*.

4. A congenital sessile tumour fixed to some part of the skull, more or less globular in shape, becoming fuller and tenser during strong expiratory efforts, partially reducible within the skull, fluctuating, with more or less well-marked expansile pulsation, is an *encephalocele.* These tumours are most frequent over the middle of the occipital bone, then at the root of the nose, or at either fontanelle; but they may occur in connection with the base of the skull projecting into the pharynx. Pulsation may be absent owing to the amount of fluid in the sac (meningo-encephalocele), and they are very generally, but not always, associated with hydrocephalus. (*See* page 385.)

5. A circumscribed globular or ovoid tumour over a large or medium-sized artery, immovable apart from this vessel, with expansile pulsation in every part, unmodified by position, collapsing to some extent when the artery above is compressed, and then yielding to pressure, filling out again when the compression is removed with a single, or two or three strong bounding pulsations, becoming a little tenser and fuller when the artery below is compressed, with a well-marked bruit conducted along the artery, and a thrill, the pulse in the artery beyond the swelling being retarded, smaller and of less tension than in the corresponding vessel of the sound side, is a *sacculated aneurism.* Should there be a history of an injury or strain, of alcoholism, syphilis, or gout, or of a sense of something giving way at the seat of the swelling; and should the heart show signs of hypertrophy while the arteries show signs of general degenerative disease, this diagnosis will be confirmed. An aneurism may not be compressible if there be a great deposit of clot in its cavity, although there will be slight modification of tension produced by compression of the artery above or below. Bruit and thrill may both be absent, but *not often.* *If* punctured, bright-red blood spurts

out in jets as from a wounded artery. If it be noticed that the aneurismal tumour becomes more clearly defined, firmer, with a less superficial and a less clearly expansile fluctuation, while it is less compressible and reducible, it indicates the *gradual obliteration* of its cavity by clot. When the tumour is firm, incompressible, and exhibits a heaving and not an expansile pulse, it shows that the *aneurism is entirely obliterated*, but the artery on which it is placed is pervious. Such a tumour, if seen for the first time in this condition, would have to be distinguished by its fixity to the artery from an independent solid tumour over the vessel. When all pulsation ceases in the firm contracting tumour, it shows that the artery also is obliterated. Should it be found that the tumour grows somewhat rapidly, and that its outline becomes less defined and its pulsation less distinct, a small rupture of the sac or *bursting of the aneurism* may be recognised. But if either spontaneously, or after some injury or strain, the tumour become greatly and rapidly increased in size, with an entire loss of its clearly-marked outline, an alteration in the tone of its murmur, and it be incompressible and unaltered in tension by compression of the artery above, with great weakening or loss of its pulsation, loss of pulse in the arteries below, ecchymosis of the skin, with rapid œdematous swelling, it is to be recognised as a *ruptured* or *diffused aneurism.*

6. If a tumour fixed to a bone have an expansile pulsation which is uniform or present in certain situations only, and is unmodified by position, and if it neither collapse nor be compressible when the artery above is pressed upon, the pulsation returning at once when the pressure is removed, and do not become more tense when the main artery below is compressed, it is a "*pulsating tumour.*" If *the tumour* have been first noticed away from the

site of a main vessel, or have shown pulsation only late in its history, if the bone can be traced over its base or surface for any distance, if there be "egg-shell crackling," or spontaneous fracture of the bone, a fungous protrusion of the tumour through the skin, or other growths in different parts of the body, the diagnosis is rendered much more certain. These tumours are often of irregular outline and of varying consistence at different places; a soft blowing murmur may be heard in them.

7. If a tumour be found over a large artery, with a heaving impulse, neither collapsing nor compressible when the artery above is controlled, nor increasing in tension when the artery below is compressed, and if the impulse at once return in its original force on removing the pressure upon the vessel, and if there be no murmur, or a systolic murmur not of the blowing character met with in aneurisms, and especially if the pulsation be lessened or lost with alteration in the position of the tumour, or it can be moved apart from the artery, it is a *solid tumour over an artery* with communicated pulsation. A bruit and thrill are usually absent in such cases, as well as the characteristic alterations in the arterial pulse beyond the tumour; but each may be met with or may be produced by pressing the tumour more firmly against the vessel. Should the tumour fluctuate, and be incompressible and immovable, with an ill-defined outline, unaltered except in the one matter of pulsation by control of the artery on the cardiac side, and especially if there are signs of inflammation in the part (redness, heat, pain, fever), it is an *abscess over an artery* with communicated pulsation. If, however, the tumour, with these general characters, be found to be compressible and reducible, whether the artery above is controlled or not, and it fill out again gradually are not *per saltum*, a *reducible tumour over an artery*,

which, if in the ham, will probably be found to be a synovial cyst, is to be diagnosed. *A cyst over an artery* not communicating with a joint or other cavity resembles an abscess, except that it is more defined in outline, very chronic in its course, without signs of inflammation; it may be translucent, or situated in some part, *e.g.* the thyroid gland, in which cysts are common.

8. If, after an injury or strain, an ill-defined swelling suddenly or rapidly develop over a large artery, with expansile pulsation, rough bruit, and thrill, with gradually increasing tension and cutaneous ecchymosis, and the tumour be not compressible when the artery above is controlled, and there is abolition of the pulse and venous obstruction with œdema below the swelling, it is a *ruptured artery.* If an aneurismal swelling suddenly and rapidly increase, losing its clearly-marked outline, with an alteration in the tone of its murmur, and the other signs mentioned above, it is a *diffused or ruptured aneurism.* If the case be seen for the first time when the aneurism has ruptured, the diagnosis between a ruptured artery and a diffused aneurism will rest upon the history; in the one case an injury or strain, in the other a history of a swelling of some long standing, in which the patient has perhaps noticed a "beating" neuralgic pain down the limb from pressure on the nerves, or venous distension from pressure on the veins, and the vessels may be found atheromatous and the heart hypertrophied. As regards the abolition of the pulse in the arteries below an aneurism, it must be remembered that while this, when taken with other signs, is a most characteristic sign of a ruptured artery or diffused aneurism, alone it must not be depended upon, for it may be caused by the gradual growth of an aneurismal tumour compressing and then obliterating the mouth of an artery, or by plugging of the artery by

a portion of clot displaced from the sac. Where an artery is ruptured completely across, or an aneurism ruptured by a large aperture, the tumour is devoid of pulsation.

9. The diagnosis of abscess or other tumour associated with aneurism is fraught with great difficulties. The presence of an abscess will have to be determined by the usual signs of that affection, the ill-defined swelling, fluctuation, redness, heat, severe pain, and pyrexia. The association of aneurism with it may be suspected from the history of the case, and the suspicion becomes confirmed if a blowing bruit be detected; and if, in addition to that, it be found that the swelling collapses somewhat, and is compressible when the artery above is controlled, and then fills out again with successive thuds when the compression is removed, the diagnosis of *abscess over an aneurism* becomes certain. If one part of a pulsating swelling be found to be more or less clearly marked off from the rest, and to have a heaving and not an expansile impulse, to be unyielding when the artery above is compressed, and to be movable apart from the rest of the swelling, a *solid tumour over an aneurism* is to be recognised. Should a swelling with these general characters be found to fluctuate (there being no signs of inflammation), and especially if it be found compressible quite apart from controlling pressure on the artery above, and that it fills out gradually, a *cyst and aneurism* must be diagnosed. Finally, it is to be pointed out that in every case of swelling over an artery careful auscultation is to be practised to determine whether the soft blowing murmur so characteristic of aneurism is present, and in no case is a diagnosis to be arrived at until aneurism has been excluded. Careful puncture with a fine-grooved needle may be of use in diagnosing the more difficult cases.

CHAPTER XIX.

THE DIAGNOSIS OF SWELLINGS IN CONNECTION WITH BONES.

In this chapter it is intended to discuss the diagnosis of that large and very important group of swellings which are fixed to, and immovable apart from, bone. In the case of deep and infiltrating tumours of the soft parts great care may be required to distinguish them from tumours growing from and adherent to the bone; but the diagnosis is of great importance, as the treatment in the two cases might and probably would seriously differ. It may be quite impossible to distinguish between some swellings connected with bone, and those of similar nature immediately surrounding the bone, as *e.g.* between a periosteal and parosteal abscess, and between a periosteal and parosteal sarcoma; and it is only by an exploratory incision into the swelling that the diagnosis can be made with certainty. The special tumours of particular regions, such as spina bifida, tumours of the jaws or the skull, will be discussed in the chapters on regional diagnosis. Having determined that a given swelling is connected with the adjacent bone, the surgeon should proceed with his examination in the following way.

1. **Ascertain the history** of the swelling. First, whether it is *traumatic* or *spontaneous*, then whether it is *acute* or *chronic*, and finally whether it has continuously *enlarged*, remained *stationary*, or *receded*. *Traumatic swellings* may be dislocations, fractures, hæmatomata, inflammatory, or neoplastic, for an *injury* may be the true starting point of a tumour-growth, or a tumour may only become apparent when

some trivial injury has broken across the thin shell of surrounding bone, as in cases of central sarcoma of the shaft of a bone; where a history of injury is given, care must be taken to ascertain whether there were any symptoms, such as local pain, previous to the injury, and whether the injury is a sufficient explanation in itself of the subsequent course of events. *Spontaneous* swellings are inflammatory, neoplastic, and diathetic. The acute specific fevers are liable to be followed by inflammatory swellings of the periosteum. *Acute swellings* are either the direct results of injury (dislocation, fracture, effusion of blood), or inflammatory. *Chronic swellings* may be the secondary results of injury, such as the thickening round a badly-set fracture, inflammatory, neoplastic, or diathetic. *Swellings* that *progressively enlarge* may be inflammatory or neoplastic; very rapid steady growth is a sign of inflammation, while steady enlargement over a long period and to a great size is a frequent and sometimes very characteristic feature of new growths. *Stationary swellings* may be the result of injuries, of chronic inflammation, or some forms of benign tumour. *Receding swellings* are always inflammatory or the result of injuries, as *e.g.* callus round a fracture, and nodes.

2. **Examine the tumour** and ascertain the following facts:

(*a*) Whether *single* or *multiple*. Multiple swellings indicate the influence of a diathetic cause, as struma, syphilis, rheumatism, gout; or of infection, as in some cases of secondary sarcoma and carcinoma of bone; multiplicity is also a frequent feature of some simple tumours, such as enchondroma and exostosis. Inquiry should be made to ascertain whether the multiple tumours originated simultaneously (pointing to some diathesis) or appeared successively, and at such a *period subsequent* to the formation of a first tumour as to support the view of infection. When multiple, too, it should be noted whether the swellings are symmetrical or not; rachitic tumours are symmetrical, those of congenital syphilis generally are not.

(*b*) Ascertain whether there are many of the usual *signs of inflammation*, such as local heat, redness, œdema, pain, tenderness on pressure, loss of function apart from gross mechanical causes, and fever with its attendant effects. This will, of course, have great influence upon the diagnosis, as separating at once the large groups of inflammatory affections. The pain of inflammation of bone is usually (not always) a marked feature, and is of a deep boring or aching character, and is very often worse at night or under any influence increasing the local vascular engorgement.

(*c*) Examine the *consistence of the swelling*, to determine whether it is *solid* or *fluid*, *uniform* or of *varying consistence* in different parts. Fluid swellings are either abscesses or cysts; variation in the consistence of a swelling in different parts is a characteristic sign of sarcomatous tumours of bone, but may be caused also by inflammation at one part running on to suppuration.

(*d*) *Pulsation* is a striking feature of some sarcomatous tumours of bone, and is never met with in other bony swellings. (*See* page 304.)

(*e*) Notice the *part of the bone affected*, whether the epiphysis, the diaphysis, or the line of junction of the two. Rachitic, congenital syphilitic, rheumatic, gouty, chronic inflammatory processes, abscess and central sarcomata, affect epiphyses; inflammation acute and chronic, sarcomatous, fibrous, and cystic tumours, attack diaphyses; exostoses grow most often opposite the line of junction of the two parts.

(*f*) Notice the relation of the swelling to the soft parts over it, whether *infiltrating* or merely *displacing* (inflammations and sarcoma infiltrate), and also the *shape* of the swelling, whether enlarging away from the bone as an exostosis, or spreading along the bone as a subperiosteal sarcoma, or expanding the bone over it as a central sarcoma; this may occasion egg-shell crackling.

(*g*) Then notice the state of *the neighbouring joint*, whether there is effusion into it or limitation of its movements; if the latter, whether it is explained by the mere increased size of one of the bones; whether grating or friction from disease of cartilage or exposure of bone, or pain. Inflammatory affections of bone may be associated with inflammatory changes in the adjacent joints. New growths in articular bones only interfere mechanically with the function of the joint.

3. **Investigate the general condition** of the patient, looking especially for evidence of rickets, of syphilis, of struma, of gout, or of anæmia and hectic. The bearing of such facts upon the diagnosis is evident, and it need only be remarked that they must not be overstrained, for a strumous patient may suffer from a syphilitic or sarcomatous tumour, and a syphilitic child may have a growth of exostoses quite independent of his diathetic state.

Such an examination will afford the means for a diagnosis. The diagnosis of the individual injuries of bone has been discussed in previous chapters.

If the swelling be acute, it is either

Dislocation.
Fracture.
Hæmatoma.

Periostitis.
Deep abscess.

For the diagnosis of *Dislocation* and *Fracture, see* pages 30, 32.

If the swelling be congenital or immediately following upon an injury, and fluctuate, it may be recognised as a *hæmatoma.* (*See* page 77.)

But if the swelling have developed independently of injury, or if it have quickly but not immediately followed it, and there be the local signs of inflammation, with high temperature, quick pulse, and all the other signs of fever, it is *acute periostitis.* Of this there are two forms, *circumscribed* and *diffuse.*

Circumscribed acute periostitis is generally due to an injury, sometimes to syphilis, or zymotic disease, and the history and accompanying signs of disease will determine this point. It is most common in the tibia. Examine the part carefully for fluctuation, which will indicate a *periosteal abscess.*

The *diffused acute periostitis* is a much more serious affection; it is met with in children about puberty, most often affecting the lower end of the femur, but it may occur in other bones. When attacking the femur the swelling is deep, the skin over it is shiny, pitting on pressure, pain and tenderness are very severe, and when suppuration has occurred, fluctuation will be obtained with difficulty; there may be effusion into the neighbouring joint, as the knee. The constitutional signs of this disease are most marked, the fever is very high, often attended with rigors (one or more) followed by sweating, the pulse is rapid and feeble, the tongue furred, and in some cases there is delirium. If the disease be allowed to take its course untreated, it frequently ends in *pyæmia.* The occurrence of a rigor and the presence of œdema are signs of suppuration, which may be acted upon in the absence of fluctuation. When the abscess is opened the bone is found bare, more or less extensively, and sometimes the epiphysis is separated from the diaphysis. A *deep abscess* unconnected with bone would be indistinguishable from the above except by finding, when opened, that the bone was nowhere exposed.

If the swelling be chronic it may be due to

- Hypertrophy.
- Rickets.
- Inherited syphilis.
- Badly united fracture.
- Periostitis.
- Abscess.
- Osteitis deformans.
- Necrosis.
- Caries.
- Tumour.

Occasionally, without any symptoms of disease, the bones of one limb, or of one side of the body, are found larger than their fellows, and such must be spoken of as *hypertrophied.* This name is also often given to the elongation which sometimes ensues upon inflammation of the epiphysis of a growing bone, or to the thickening resulting from chronic inflammation.

If multiple symmetrical swellings occur in a child, being found at the ends of the ribs, and over the junction of the epiphyses and diaphyses of the long bones, especially at the lower end of the radius and tibia, and if with these there are signs of softening of the bones (bending, delay in ossification, open fontanelles), the diagnosis of *rickets* may be made. In many cases of rickets there are other well-marked signs, such as profuse sweating, especially about the head, with falling off of the hair, late dentition with early decay of the teeth, flabbiness of muscle or emaciation, "pigeon-breast," "pot-belly," enlargement of the liver and spleen, vomiting, diarrhœa and general tenderness of the surface.

If the swelling occur in an infant or young child, especially if it affect the vault of the cranium, humerus, or tibia, be most marked over the epiphyseal line, and gradually subside up the shaft, especially if there be mobility of the epiphysis on the diaphysis, with soft or grating crepitus or suppuration, it is *syphilitic disease of the bone.* Other signs of inherited syphilis should be sought for. The disease may attack many bones, but in the limbs is not generally symmetrical.

If the swelling be at the site of an old fracture, be stationary, hard, and painless, it may be recognised as a deformity due to union of the fracture in a bad position. In fractures where there has been much comminution of the bone, or laceration of the soft parts, the mass of callus effused is but slowly absorbed, and signs of it may be found for many months as a firm, painless swelling round the bone.

If the swelling be slowly formed, attended with pain of a deep, boring, aching character, becoming worse at night, and there be local tenderness and hyperæmia, the tenderness being especially elicited by sharp percussion, it is *chronic periostitis.* Of this, several varieties must be distinguished.

(*a*) If the whole diaphysis of a bone be enlarged, the swelling firm, slightly uneven in outline, stationary or but slowly advancing, it is *chronic diffuse ossifying periostitis,* and is probably associated with *sclerosis* of the bone from *chronic ostitis.*

(*b*) If the swelling be limited to one portion of the bone, it is called *circumscribed periostitis.* If this swelling be of stony hardness, and very chronic, it is known as a *hard node* or chronic ossifying periostitis. If, on the other hand, it be softer, and especially if it fluctuate, it is a *soft node,* and in the latter case a *periosteal abscess.*

(*c*) *Syphilis* is a very frequent cause of nodes, and syphilitic periostitis may be recognised by the accompanying signs of this dyscrasia, either inherited or acquired, or by the tendency of the nodes to recur and to ossify, and to attack especially the diaphyses of the tibia and clavicle. Occasionally syphilitic nodes soften down into abscess, or they may slough like ordinary gummata.

(*d*) *Struma* is the other constitutional cause of chronic periostitis. It very frequently affects the bones *of children,* and is accompanied by other signs of struma, such as glandular enlargements and abscess, scrofulides, ophthalmia, anæmia, etc. Locally, it is distinguished by its affecting especially the ends of long bones, or the bones of the fingers and metacarpus, by its little tendency to ossification, but its great tendency to soften down slowly into abscess.

If there be a slight localised swelling of the articular end of a long bone, which is the seat of constant and long-continued aching pain especially at night, with marked tenderness to pressure or a smart tap just at spot, and if, further, there be slight swelling of the deep soft parts over the bone, an *abscess* in the bone may be suspected. This affection occurs most frequently in either extremity of the tibia.

If the enlargement of the bone occur in a man past middle life, be very chronic in its course, increase the length and the diameter of the bone, affect many bones (skull, spine, clavicles, humerus, femur, tibia, etc.), and be attended with "rheumatic" pains, and a yielding of the long bones to pressure, the disease is that named by Sir James Paget *osteitis deformans*, and often now spoken of as *Paget's disease of the bones.*

If the enlargement of the bone be attended with suppuration, and on opening the abscess, or on probing the sinus left by such abscess, hard, smooth, bare bone be felt, *necrosis* has occurred. In some cases, as the skull, tibia, and the jaws, the necrosed bone can be seen, and if it has been long exposed to the air the sequestrum becomes dark in colour. In other cases a diagnosis of necrosis may be made by the peculiar penetrating offensive odour of the pus escaping from the abscess or sinus; this feature is very marked in necrosis of the jaws.

In some cases of necrosis of the joint ends of bone, the probe cannot be made to strike the sequestrum, but a diagnosis can be made by observing the *peculiar firm* smooth grating elicited on manipulating the affected bone, different from the roughened crepitus elicited in cases of caries, and the softer crepitus in some cases of rheumatoid arthritis.

If the swelling affect the cancellous end of a long or short bone, and there be pain, increased by pressure upon or through the enlarged bone, with some swelling and matting together of the soft parts over the bone, and especially if there be redness of the skin and œdema, or fluctuation from the presence of pus, the diagnosis of *chronic ostitis* may be made. If suppuration have taken place, and if the probe passed along the sinus strike softened porous bone, the condition is commonly called *caries.*

If the tumour occur in a child or young person, grow slowly or remain stationary, be attached to a long bone at the line of junction of its epiphysis, and if it be of stony hardness, prominent, painless unless from pressure upon an adjacent nerve or from injury, it is an *exostosis.* These may be single or multiple, rounded or lobulated; they are most frequently met with at the lower end of the humerus and femur, and the upper end of the tibia. They may have a bursa developed over them. They commence as cartilaginous outgrowths, and so long as their growth continues a layer of cartilage will be found over the bone, but when the whole tumour is ossified growth ceases. Bony tumours are met with in other special situations as the skull and the great toe. (*See* pages 384, 562.)

If the tumour occur in the hand of a young person, be of slow, steady, and painless growth, globular in outline with rounded projections from the surface, be firm but not absolutely unyielding to pressure, with smooth surface, and especially if a sense of "egg-shell" crackling be obtained on gentle pressure, a diagnosis of central *enchondroma* may be arrived at. These tumours are frequently multiple.

If the tumour be of steady growth, of irregular outline, varying in density at different situations from firm to soft and semi-fluctuant, and especially if the tumour have attained a great size, or pulsate, or have dilated blue veins coursing over it, and be attended with œdema of the limb, and if there be "egg-shell" crackling at one or more spots over it, it is a *sarcoma.*

The varieties of sarcoma cannot with any certainty be distinguished from one another without microscopical examination; but attempts should always be made to diagnose the primary seat of the growth.

If the tumour implicate and expand the epiphyseal end of a bone, showing but little tendency to spread up the shaft, and particularly if it pulsate, or give a sensation of "egg-shell" crackling anywhere on the surface, it is a *central sarcoma*, springing from the cancellous tissue of the articular end of the bone and gradually expanding and destroying the bone in its growth. These tumours are chiefly met with at the lower end of the femur, upper end of the tibia and fibula, and in the head of the humerus.

If, without any swelling having been noticed, "spontaneous" fracture of the shaft of a bone occur and be followed by the continuous growth of a tumour with all the general characters of sarcoma, it is a *central sarcoma* of the shaft of the bone, the neoplasm having started in the medullary canal and gradually destroyed the bone over it until the thin shell snapped by some trivial strain, and the tumour, set free from its bony case, grew with increased rapidity and became palpable. In the early stage pain is the only symptom. These tumours have been noticed with special frequency in the femur.

If the tumour avoid the very extremity of the bone, spread along the shaft of the bone, grow rapidly and attain a large size, without "egg-shell" crackling, or pulsation, the tumour is a subperiosteal *sarcoma.* These tumours often appear to start about the junction of epiphysis and diaphysis, but in their growth to leave intact the former; they tend to form elongated and ovoid, rather than globular, enlargements of the bones, and to be of very varying consistence owing to their frequent chondrification and ossification. The lymphatic glands of the part may be enlarged. The tumour may be seen fungating through an ulcer in the skin. They grow faster and are more malignant than central sarcoma. They are met with specially at the lower end of the femur, upper end of the tibia and fibula, lower end of the radius and ulna, and involving extensively the diaphysis of the humerus.

When an incision is made into such a tumour the periosteum is found raised over the new growth or entirely destroyed, and the bone is bare beneath the tumour. Should, however, the periosteum be found entire, the bone nowhere exposed, and the tumour altogether outside the periosteum, the growth is a *parosteal sarcoma*; this is a very rare form of the disease, and impossible to recognise without an exploratory incision.

If a tumour in connection with the shaft of a bone grow very slowly, assume a globular smooth outline, be very firm and painless, a *fibroma* may be diagnosed. In general features it will most nearly resemble enchondroma, from which it can only be distinguished by its position, ossifying enchondromata starting from the junction of epiphysis with diaphysis, and central enchondroma affecting the long bones of the hand. From sarcoma it will be distinguished by its more chronic course, its very slow growth or even stationary character, and the absence of fracture or pulsation. Fibroma is a very rare tumour of bone except in the form of fibrous epulis. (*See* page 393.)

Other tumours, rare in occurrence and still more rarely diagnosed, are *hydatid cysts of bone.* They have been found in connection with the flat bones, or in the shafts and articular ends of long bones. In the shafts of long bones their first symptom is generally "spontaneous" fracture, with subsequent non-union, and then when an operation is undertaken the hydatid cysts escape. They may be suspected when after "spontaneous" fracture union does not occur, and a sarcomatous tumour does not develop. In other situations they cause a smooth globular distension of the bone, and their nature can only be suspected before operation. These tumours are likely to be mistaken for central sarcoma, from which, however, they differ in their greater chronicity.

Carcinoma only occurs as a secondary growth in bone. The so-called "*blood cysts*" and "*fibro-cystic*" tumours of bone are but varieties of *sarcoma.* Satisfactory evidence of the existence of true *osteo-aneurism* is wanting. (For the diagnosis of *Cystic tumours of the jaws*, *see* page 389.)

CHAPTER XX.

GENERAL DIAGNOSIS OF ULCERS.

The diagnosis of an ulcer includes the recognition of its condition and its cause. In many cases observation of the former decides the latter; for the one, attention is directed solely to the state of the ulcer itself, without any reference to the general condition of the patient, to concomitant affections or to the progress of the sore; all these demand investigation when we have to decide upon the cause of an ulcer. As the natural and also the simplest and most convenient method to adopt, we shall first discuss the diagnosis of the conditions of ulcers and then that of their causes. It will be best first of all to study the general features of ulcers, and the modifications they present under different circumstances. These features are five in number: (1) *the base* of the sore; (2) its *edge;* (3) the *surrounding tissues;* (4) the *discharge;* and (5) the *pain*, if any, associated with it.

(1) **The base of an ulcer** may be *shallow* or *deep*, indicating a slight or a more extensive loss of substance. It may be *smooth*, more or less glistening and pale in colour, indicating an entire absence of all activity. It may be covered with *granulations*, indicating a more or less perfect attempt at healing; or it may show a *sloughy* surface, indicating the death of tissues by gangrene; an *eroded, irregular surface,* with flocculent shreds adherent to it, may show that the ulcerating process is still advancing; or the base may be covered with special structures, such as the "bullock's liver-like" clot of *scorbutus*, or the false membrane of *diphtheria.*

More important still is *infiltration* of the base; this may be slight or exaggerated, and its characters differ much in different cases; it is recognised by the thickening of the tissues forming the base of the ulcer. In such cases the base may be deeply excavated, very uneven, warty, or granular, or may be covered with fungating masses of new growth, which protrude beyond the skin.

Among the special characters of the base of an ulcer are those which constitute it a *sinus* or a *fistula.* If the ulcer assume the form of a long passage into solid tissues it is a *sinus;* but if it form a direct communication between adjacent mucous surfaces, or between the skin and a mucous surface, it is a *fistula;* this term is also sometimes used to designate a sinus leading into any of the natural cavities of the body, such as a joint or the pleura.

The granulations found on ulcers or wounds vary much. Typical healthy granulations are bright red in colour, small, uniform in size, forming an even layer, neither painful nor tender, not readily bleeding on gentle contact, and discharging a small amount of laudable pus. As departures from this we see small, scattered, irregular, and congested granulations, where the formative material is deficient and the venous circulation impeded; in other cases large, florid, soft, readily-bleeding granulations testify to abundant cell growth with deficient organisation and congestion; and yet again, granulations of large size, uneven outline, pale colour and soft consistence, with abundant thin purulent discharge, indicate that the capillaries of new formation are scanty, and that the granulation tissue is sodden with exuded serum. A granulating surface may lose its vascular appearance, becoming converted into a grey or greyish-yellow firm "rind" or slough; this is spoken of by some as "croup" of an ulcer. When attended with severe local inflammatory symptoms and fever, it is called "diphtheria" of an ulcer. Another appearance, which, when it exists, is quite characteristic of tertiary syphilitic sores, and in them is often seen, is a raised base of a grey or pinkish-grey colour, glistening appearance, and very firm consistence; if pierced by a probe it is found to be much firmer than granulation tissue, to bleed but little, and to be insensitive, while its surface may show some signs of granulation; it is very enduring, and is quite distinct from a slough.

(2) **The edge** of an ulcer may be *sloughy*, or irregular, with an eroded appearance, and of a deep red colour indicating that it is still *ulcerating*. When it is shelving in character, gradually merging into the granulating base, and marked with three concentric zones, the innermost being narrow, deep red in colour and smooth, the middle of a pale purplish hue, the

outermost milk-white in colour and covered with soft epidermic scales, the ulcer is *epitheliating*. A *sharply-cut edge* with a punched-out appearance points to an equal loss of superficial and deep tissues, usually caused by the separation of a slough. A *rounded edge*, thickened, and adherent to the deeper parts, shows that the ulcer is of long standing, and neither healing nor advancing; to be distinguished from this is the *infiltrated edge*, firm, more or less swelled, and usually uneven, continuous with an infiltrated base, lacking the rounded smooth appearance of the above; it points to the ulcer being secondary to an infiltration of some kind, syphilitic, lupous, or cancerous. The edge may be *undermined*, and the undermined part may be thin or thick, variously coloured, and of different extent; this shows that the subcutaneous tissues have been more widely destroyed than the skin, and that the ulceration has especially attacked the deeper parts; it is most often seen when the ulcer has been formed by the bursting of an abscess or the detachment of a slough. Again, the edge may be *everted;* this is a frequent feature of ulcerating cancers. Or the edge may be *concealed* by a sprouting mass of granulations, or a fungating tumour. The edge may be straight, circular, or irregular, and may become very irregular by the coalescence of adjacent ulcers; if these should have been circular, a characteristic curvilinear outline is produced.

(3) **The condition of the tissues surrounding** an ulcer often throws much light upon the diagnosis. They may be *quite healthy*, which is an indication that the ulcer is the result of a strictly limited affection, all the implicated tissues having been destroyed; it is a frequent sign of late syphilitic ulceration. They may be *inflamed*, hot, red, painful, tender, and more or less swelled and œdematous, or showing an eczematous condition of the surface;

enquiry must then be made as to whether the inflammation or the ulcer was primary. The tissues may be *indurated, matted together*, and more or less congested and pigmented, with warty projections, or covered with scaly and unhealthy epidermis, owing to prolonged congestion and infiltration leading to the production of a coarsely fibrillated and cellular tissue, and hypertrophy of the papillæ. The great thickening of the epidermis around the orifice of a perforating ulcer of the foot is an exaggerated example of this condition. Distinct from this is the clearly circumscribed *infiltration* of the tissues with a malignant neoplasm, in which there is a tumour having the features characteristic of one or other of the cancers or sarcomas. In some cases the surrounding skin is found *cold, livid*, and benumbed from very torpid circulation. Particular attention should be paid to the neighbouring vessels (induration, tortuosity, or obstruction of the arteries, varicosity, or occlusion of the veins), and also to the functional activity of the nerves, as indicated by disordered sensation, motor paralysis, and intense local sweating.

(4) **The discharge** from an ulcer may be *laudable pus*, and if this be in small quantity it is a sign of healthy action; if the pus be *abundant and thin* it shows a rapid breaking down of granulation tissue, and therefore an imperfect organisation. The discharge may be *thin* and *ichorous*, indicating an abundant serous effusion, with insufficient cell-exudation and cell-proliferation; such discharge, especially when the ulcer is sloughy, quickly decomposes, and becomes foul-smelling. It may be *sanious*, showing a delicacy of capillary wall, or exaggerated intravascular pressure. It may deposit on the neighbouring skin, or when dried, a white chalky sediment of *urate of soda*, indicating very clearly the gouty nature of the ulcer. Or pus may be found rich in *lime* salts, showing that

it is in part the result of the disintegration of bone. In other cases the true discharge of an ulcer may be mixed with *special excretions,* such as urine, fæces, milk, saliva, bile, etc. The *infective nature* of the discharge from some ulcers is a fact of great importance; auto-infectivity is shown by the occurrence of secondary ulcers on those surfaces exposed to the action of the discharge. The *microscopical examination* of a discharge may throw light upon the nature of the ulcer, revealing special cell forms, or even micro-organisms; this subject is ably dealt with in Pepper's "Elements of Surgical Pathology."

(5) **The pain of an ulcer** may be nil; or it may be the continuous, smarting, stinging, burning pain of inflammation and active ulceration. Pain of special significance is that which occurs apart from signs of local inflammation, is very intense, often radiating along the nerve distributed to the ulcerated skin, and especially excited by movement of the ulcer or contact with its surface; in some such cases, the probe detects one particular spot in the ulcer, the least touch of which causes a severe paroxysm of pain; such ulcers are well called *irritable.* In these cases it is believed that a nerve filament or cord is exposed in the base of the sore.

A. **Diagnosis of the condition of an ulcer.** —Ulcers may be classed into three main groups, according to whether they show signs of healing, of spreading, or of being more or less stationary. The *first group* is characterised by the presence of granulations covering the base of the sore, and by the absence of signs of active inflammation in the edge and surrounding tissues. The *spreading sores* are characterised by the absence of all granulations over the base, the irregular and acutely inflamed or sloughing edge and base; there is also a history of progressive enlargement. The *stationary sores* are marked by the absence of the characteristic features of both the above; there are no granulations over the base, the sore is not enlarging, and the edge and surrounding skin by their thickening, pigmentation, and induration, show signs of chronic congestion.

Sinus and fistula are separately considered.

(1) **The ulcer is granulating.**—It may be:

- (*a*) Healthy,
- (*b*) Fungous, or
- (*c*) Weak.

(*a*) If the *base* be covered with an even layer of small, florid, uniform granulations, if its *edge* be shelving and marked by three concentric zones, deep red, pale purplish, and milky white, if the *surrounding tissues* be free from inflammation or infiltration, and if the *discharge* be a small amount of laudable pus, while there is no *pain*, it is a *healing ulcer*. The surgeon must remember that many grades of activity and perfection of the healing process are met with, and that epitheliation, which gives the special appearance to the edge of a healing ulcer, is usually postponed until the granulations have become level with the surface.

(*b*) If the *base* of an ulcer be covered with large, prominent, uneven, deep red granulations, which easily bleed, the *edge* being concealed by the sprouting base, or showing no signs of epitheliation, while the *surrounding tissues* are congested (or healthy), and the *discharge* is purulent and abundant, the ulcer is *fungous or exuberant;* such sores are especially seen after burns, and are often very painful.

(*c*) If the *base* of the sore be covered with an uneven layer of large, pale, flabby, œdematous granulations, which may wholly or in places project from the surface, while the *edge* is thin, pink, or purplish in colour, and undermined, and the *discharge* is a thin unhealthy pus, it is a *weak or œdematous ulcer*.

(2) **The ulcer is stationary.**—It may be:

(*d*) Chronic, or
(*e*) Irritable.

(*d*) If the *base* of the ulcer be depressed, devoid of granulations, either smooth and glistening in appearance, or dull and tawny, or covered with a thin tough rind, or a green slough, and the *edge* be rounded, smooth, inverted, thickened, and adherent to the deep fascia or base, with the *surrounding skin* indurated, thickened, adherent to the deeper parts, perhaps covered with scaly epidermis, pigmented, and marked with dilated veins, the *discharge* being thin and watery, scanty or profuse, and often very foul, it is a *chronic, callous, or indolent ulcer.* Great variations are met with in these chronic ulcers, but the features common to all are the absence of healthy granulations, and the thickening and induration of the edge and surrounding tissues. They occur most commonly upon the lower half of the leg, and generally in middle-aged or elderly persons.

(*e*) If an ulcer be attended with very severe *pain*, quite out of proportion to any signs of local inflammation, and if the base or one particular part of it be found exquisitely tender, it is called an *irritable or neuralgic ulcer;* these sores are common at the anus, and are only occasionally seen on the legs; they show no tendency to heal while the "neuralgia" continues.

(3) **The ulcer is spreading.**—It may be:

(*f*) Inflamed,
(*g*) Phagedænic, or
(*h*) Sloughing.

(*f*) If the *base* of an ulcer be depressed, uneven, or spongy in appearance, reddish-yellow in colour, with fine shreds adhering to it; if the *edge* be sharply cut, uneven, deep red in colour, or undermined; if the *surrounding skin* be inflamed, hot, red, tender, painful, swelled, or even œdematous or eczematous; and if the *discharge* be a thick greyish-yellow flocculent fluid, it is a *spreading or inflamed ulcer.*

(*g*) If an ulcer have the same general characters, but the *base* be very irregular, the *edge* sinuous and rapidly melting down, showing, perhaps, small adherent sloughs in places, and the sore enlarge rapidly and progressively, or spread in this manner by one edge while it heals at the other, it is a *phagedænic or serpiginous ulcer.*

(*h*) If the *base* and *edge* of an ulcer be covered with a slough (tough and tenacious, or soft and flocculent), the *surrounding tissues* being swollen, livid, and painful, and the *discharge* offensive and ichorous, it is a *sloughing sore. Hæmorrhagic ulcers* are arranged in a separate class by some writers, but as hæmorrhage is met with under very varying conditions, and is not peculiar to any one class of sores, this does not seem necessary.

B. **Diagnosis of the cause of an ulcer.**—Apart from the history and condition of ulcers, and the existence of concomitant affections or dyscrasiæ, there are certain factors of importance in the diagnosis which may be conveniently discussed before describing the rules for diagnosis. Under this heading reference will be made to the position, number, and shape of ulcers, their mode of origin, and the condition of the surrounding tissues.

(1) **The position of an ulcer** is often of great service in diagnosis. Speaking generally, a wide distribution of ulcers indicates their dependence upon a constitutional taint, and their *in*dependence of a purely local cause, this is frequently evidenced by syphilitic ulcerations; but care must always be taken to exclude a widely diffused local cause of the mischief, such as scabies. A local grouping of ulcers, however, is of

ulcers may be multiple, as we see in scabies and soft chancre, and not unfrequently in chronic varicose ulcers of the leg. It is only when ulcers without obvious local cause are multiple, that the fact of number becomes strong evidence in favour of their constitutional origin.

(3) **The shape of an ulcer** may be characteristic. Syphilitic sores are very commonly circular in shape, and if contiguous circular ulcers have coalesced, the sore assumes a sinuous outline which is rarely, if ever, seen in other ulcers. But still more characteristic of syphilis is it to find the ulcer healing by one border while it spreads at the other, producing reniform or annular ulcers. Strumous ulcers are generally oval, and their edge is frequently undermined. A sharply punched-out appearance indicates a marked loss of substance, and is more frequently seen in syphilitic sores than in others, but is by no means diagnostic of them.

(4) **Mode of origin.**—A careful investigation into the mode of origin of an ulcer usually throws great light upon its cause. Thus, it may be *purely traumatic*, the original injury being attended with destruction of tissue and the production of an ulcer. Other sores are what may be termed *partially traumatic*, *i.e.* the original injuries were unattended with destruction of tissue, and their conversion into ulcers has resulted from some other superadded cause, either local irritation by friction, dirt, or improper dressing; local malnutrition (impaired circulation and innervation, chronic congestion and induration), or a general cachectic state, such as is found after severe illness or in those suffering from chronic starvation. When some trifling scratch or abrasion, or the development of a small pimple, leads to the formation of an ulcer, there is one of two causes for it; either some special irritating and destructive matter is inoculated in the

wound, as, for instance, in syphilitic infection, or the tissues are so impaired in their nutritive activity that the slightest injury destroys them, or the attempt at healing results in disintegration. This is the common origin of the chronic ulcers of the leg, and of the recurring ulcers of scars.

Occasionally an ulcer is seen to originate in a small black gangrenous patch of skin, which separates and leaves a sore. This clearly points to a vascular lesion as the source of the evil, and thrombosis of the small vessels is generally believed to be the starting point of such ulcers. It is common for ulcers to result from the melting down or the sloughing of indolent indurations, papules, and nodules; the recognition of the fact throws back the diagnosis of the ulcers to that of the nodules and indurations in which they occur. We see this in lupus, where there is, first of all, a nodular infiltration of the skin, and then a disintegration of the nodules; in syphilis, too, where small or large papules, or gummata, form in the skin or the subcutaneous tissue, and by their death lead to the formation of ulcers. In epithelioma, also, there is first an infiltration of the part with the epithelial growth, and then its molecular disintegration (ulceration); and in other cancers, including sarcomata, we notice first of all the new growth, and then its partial destruction by ulceration.

Lastly, we see ulcers that originate from progressive inflammation. This assumes two forms. In the first, the inflammation is purely superficial, and is attended with disintegration spreading from the surface into the deeper tissues; of this the eczematous or catarrhal ulcer is the type. In the second form, the inflammation begins in the deeper parts, leads to the formation of an abscess, which gradually *advances to* the surface and destroys the skin from *within out*, and so forms an ulcer. The ulcers left by suppurating glands, softened scrofulides, and nearly all strumous ulcers, illustrate this mode of formation; they are subsequently characterised by a thin undermined edge. Where the separation of a slough has given rise to an ulcer, the sore generally has a sharply-cut edge, and a punched-out appearance, which are often well seen in syphilitic ulcers.

(5) **The condition of the surrounding tissues** often throws great light upon the cause of an ulcer by showing an earlier stage in the disease, or the predisposing cause of the ulcer. Thus, the skin may be eczematous, or infiltrated with lupus growth, epithelioma, or other malignant tumour; or it may be congested and thickened, adherent to the deeper structures, pigmented, with varicosity of the veins, and an unhealthy condition of the epidermis; or it may be cold and livid. In other cases the skin and the subcutaneous tissue may be the seat of scrofulides, enlarged glands, or of gummata; and yet, again, the surrounding tissues may be perfectly healthy. Where that is the case, it indicates either that the ulcer has resulted from a local cause of precisely limited area, as an injury, or that the disease is constitutional, as syphilis. The healthy state of the skin of the leg is one of the most useful and frequent distinctions between syphilitic and the common varicose, or chronic ulcers of the leg.

(6) **The condition of the ulcers** may or may not throw light upon the diagnosis of its cause; but the following propositions may be stated:

(*a*) *Weak ulcers* are most frequently "*strumous.*"

(*b*) *Indolent ulcers* are nearly always "*varicose,*" or dependent upon disorders of the circulation.

(*c*) *Serpiginous ulcers* are nearly invariably syphilitic.

(*d*) *Phagedæna* may be accepted as evidence of *syphilis, in absence* of strong evidence to the contrary.

(e) *Sloughing ulcers* are very frequently *syphilitic.*

(7) **The state of the circulation.**—A general sluggishness of circulation is necessarily attended with imperfect nutrition, and its effects are most obvious and injurious at the parts farthest removed from the heart, such as the toes, the fingers, and the ears, which are constantly cold, livid-red in colour, and subject to chilblains or local congestions on any exposure to cold. Under these conditions, ulceration is liable to occur, producing what is known as "cold" ulcer. Local disturbances of the circulation are, however, of much greater frequency. They consist in arterial degeneration and venous enlargement, congestion, and thrombosis. As causes of ulceration they are almost entirely limited to the lower half of the leg, inducing the common "chronic" or "varicose" ulcers. These local disturbances are recognised by the evident condition of the subcutaneous vessels, by œdema, induration of the tissues, with an unhealthy condition of the epidermis, and by coldness. They are specially met with in persons about and after middle age, and are most frequent in women of the lower classes of society.

(8) **The state of the nervous system** is of most interest in connection with "perforating ulcer of the foot." In some of these cases there is merely a local anæsthesia affecting one or more of the nerves of the foot; but in many other cases, the absence of knee-jerk, the lightning-like pains, the state of the pupil and the unsteady gait, proclaim the patient to be the subject of locomotor ataxy. Hemiplegia, or paraplegia, with injury of the nerve centres, may be attended with rapid ulceration and sloughing of parts exposed to pressure or irritation. (*See* page 104.) Frequent nervous phenomena attendant upon chronic ulcers are profuse local sweating and pigmentation.

(9) **The state of the lymphatic glands**

connected with the ulcerated area may throw much light upon the diagnosis. The glands may be inflamed or infected with some specific poison. In the former case the inflammation is chiefly marked around the gland, which becomes fixed by the effusion, while there is local heat, redness, pain and tenderness, and a tendency to terminate in suppuration. Any ulcer may give rise to this lymphatic irritation when itself irritated, but it occurs most frequently from traumatic ulcers, such as grazed legs and feet, and from soft chancres. Lymphatic infection, on the other hand, is characterised by an enlargement of the gland itself, which at first, at any rate, is not fixed to the surrounding tissues. It is seen in hard chancre, when many glands are affected, and become moderately enlarged, indurated, and remain freely movable; by malignant ulcers, particularly epithelioma, when the enlarged gland is at first single and movable, and later on becomes adherent, and may soften down and form an ulcer like the primary one, its growth being continuous and the infection tending to spread to other glands. Tubercle occasionally infects lymphatic glands, setting up a chronic inflammation of the gland itself, ending in caseation or suppuration. Of quite other significance, and of [illegible] less value for diagnosis, is the presence of the chronically enlarged strumous glands.

(10) **The age.**—Traumatic ulcers may be met with at any age; excluding these, the sores most common in children and young persons are strumous sores and lupus, and ulcers from congenital syphilis; in adults, syphilitic ulcers predominate; in middle life and old age 'chronic' and 'varicose' ulcers, gouty and malignant ulcers, including rodent ulcer, are most frequent. The influence of age is by no means [illegible] 'rodent ulcer' [illegible] is usually exclusively limited to the [illegible]

(*e*) *Sloughing ulcers* are very frequently *syphilitic.*

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of life, having been met with in a girl under twenty.

(11) **Cachexia.**—The cachexiæ attended with ulceration are struma, syphilis, gout and scurvy, and of these the two former are much the most frequent. The surgeon must remember that both inherited and acquired syphilis may cause ulceration, and that the former may cause large and often chronic ulcers on the legs of young persons.

There are certain ulcers the characters of which are so distinctive, that they stand out clearly apart, and can be at once recognised. We will first of all mention these, and then give the differential diagnosis of those whose features are less obviously distinctive, and which might be mistaken one for another.

(*a*) A very chronic ulcer lasting for years, occurring in an elderly person, attacking the face, and slowly destroying all the tissues (hard as well as soft), presenting a narrow indurated edge, and a smooth shallow base, showing no signs of healing, but steadily progressing, without infection of lymphatic glands, is a *rodent ulcer*.

(*b*) An irregular ulcer occurring in an infiltrating tumour is a *malignant ulcer*. This differs much in its characters, varying with the structure of the tumour in which it forms; at times it is fungating, at others deeply excavated.

(*c*) An irregular-shaped ulcer, with livid swelled edge, and the base covered with a "spongy dark-coloured, strongly adherent, fœtid crust," the removal of which causes bleeding; the patient at the same time having swollen spongy or ulcerated gums, petechiæ on the legs, and deeper brawny swellings, with a sallow anæmic appearance, is a *scorbutic ulcer*. The history will throw light upon the diagnosis of such an ulcer.

(*d*) An ulcer situated in a diffused area of reddened swollen skin, with adherent scales or crusts of epidermis and dried discharge, is an *eczematous ulcer.* Such sores are often multiple. It is important to determine that the eczema preceded the ulceration, as sometimes the discharge from an ulcer, or an improper mode of dressing, causes an eczematous condition of skin around an ulcer of quite a different origin.

(*e*) A very chronic ulcer on the sole of the foot, surrounded by thick horny cuticle, deep, and leading down towards or to bone is a *perforating* or *trophic ulcer.* This is frequently associated with locomotor ataxy, or with local anæsthesia; these ulcers may be multiple. They have been met with in connection with caries of the spine, congenital club-foot, and also in leprosy.

(*f*) A small round or oval ulcer, with thin livid edge and smooth shallow base, situated on or near the tip of a finger or toe, in an individual whose hands and feet are habitually cold, and quickly become livid on exposure, with a weak compressible pulse, is a *cold ulcer.*

(*g*) An ulcer occurring over a gouty deposit, small, shallow, and smooth, the discharge from which may leave a white chalky deposit on the surrounding skin, is a *gouty ulcer.* There will be the history and other evidences of gout to aid in the diagnosis.

The remaining ulcers may be divided into two groups, one consisting of those which have originated in the gradual molecular disintegration of the surface of solid deposits or growths, and which are found as ulcerated nodules or tubercles, the ulcer being surrounded by the original induration; and the other group in which the ulcers have formed by the molecular death of the original tissue of the part or the sloughing of the whole of a deposit; in such cases if there be any induration round the ulcer it is secondary to it, and ill-defined. Excluding rodent ulcer and malignant ulcer, whose characters are so very distinctive, the ulcers belonging to the first group of ulcerating indurations are

Lupus.
Epithelioma.
Chancre.
Syphilis (the ulcerating papule).

If the ulcer be single, and occur in a person otherwise healthy, if it be acute in its course, with well-marked induration of the base and edge, the ulceration being, perhaps, not more than a superficial abrasion, and if the neighbouring group of lymphatic glands be enlarged and indurated, but movable under the skin and over each other, and if the sore be followed by a dusky papular rash, papules on the fauces, or mucous patches, and any of the secondary effects of syphilis, it is a *Hunterian chancre.* The diagnosis rests mainly upon the succession of symptoms, first the local induration, then the indolent buboes, and later on the rash, etc. ; the local induration is characterised by its flatness and continuity : it is not tubercular, nor made up of several nodules as is lupus ; the buboes are painless, multiple, and not adherent. Hard chancres are only very rarely multiple.

If the ulcer be chronic, situated in a nodular tubercular eruption on the face or hand, which commenced during childhood or youth, has only very slowly broken down, and has left scars behind, it is *lupus.* Of this there are several varieties described, the most common being *lupus vulgaris*, which is most frequent on, but not limited to, the face, and in which the tubercles are well developed, and *lupus erythematosus*, which first attacks the nose and adjacent parts of the cheeks, then spreads to the hands, and is very rare in other situations; it is nearly always symmetrical. By the chronicity of the growth it is distinguished from chancre and epithelioma; and it differs from the ulcerating tubercles of syphilis in the greater softness and vascularity of the tubercles; its much slower and less destructive course, and the absence of scattered tubercles around the patch, as well as by the different associated affections.

A chronic ulcer situated in a firm tubercle, deep, with a punched-out appearance, with other firm tubercles scattered around, occurring in an adult, with signs or a history of constitutional syphilis (and usually such ulcers are not the sole manifestations of syphilis present), is a *syphilitic ulcer*, the ulcerating syphilide or tubercle.

An ulcer occurring in a person at or past middle life, commencing in a wart or fissure, steadily progressing, with an indurated everted edge, and indurated uneven base, covered with firm pink granulations with yellow specks, with enlargement of the neighbouring gland or glands, which become adherent to the surrounding tissues as they enlarge, is an *epitheliomatous ulcer*. These ulcers are most common on the lips, tongue, penis, scrotum, vulva, and anus, around old sinuses, or in old scars. They are very rarely multiple. The age of the patient, the progressive character of the affection, the infiltrating enlargement of the lymphatic gland are eminently characteristic. If the surface be scraped, and the scraping examined microscopically, large quantities of epithelial cells are found, and perhaps an epithelial "globe," or "nest," may be detected. (*See* page 273.)

The second group of ulcers includes

Traumatic.	Strumous.
Varicose.	Syphilitic.

An ulcer occurring in a healthy individual, and in healthy tissues, as the result of an injury, is a *traumatic ulcer*. Injury often enters into the production of other ulcers, especially the so-called "varicose" ulcers.

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(*d*) An ulcer
dened swollen

In *caries* the granulations of the sinus are more vascular, the passage of the probe is painful, and is attended with some hæmorrhage, while the bone is felt to be soft, irregular, and yields a grating sensation, and not a clear ringing sound when tapped; these distinctive characters are only observed in typical cases. If neither of these causes for the sinus be found the surgeon must see whether the cavity *drains* efficiently, as retention of discharge is a very common cause of non-healing; in other cases he will find the sinus runs between muscles or other structures which are constantly being *moved* over each other, and rest, with fixation of the part, is the condition necessary to healing. Associated with any of the above causes of sinus, or alone, the surgeon may find an unhealthy condition of the *lining of the cavity* and the surrounding tissues, and a *strumous* habit of body. The examination of a sinus, therefore, consists first in the investigation of local conditions, *i.e.* foreign bodies, disease of bones and joints, passage of any of the fluids of the body, imperfect drainage, movement of the parts around, atonic condition of the lining membrane, and then of the constitutional state of the patient.

CHAPTER XXII.

THE DIAGNOSIS OF GANGRENE.

THE diagnosis in a case of gangrene consists in the recognition first of the fact of the death of a mass of tissue, secondly of the variety of the gangrene, and thirdly of its cause.

A. **Gangrene is recognised** by several signs which are variously combined in different cases.

(1) In **complete anæsthesia,** the part is quite insensible to contact or the prick of a pin. This sign is invariably present in gangrene, but it must be remembered that alone it is not evidence of tissue-death, as it may be due to palsy of a sensory nerve. It must also be borne in mind that although dead tissue is quite insensible, its manipulation while it is in connection with living tissues may cause pain; thus, in the case of a boil, where the central slough is exposed, a needle may be passed into the ash-grey slough without exciting any pain, but if it be grasped with a forceps, the traction upon the adjacent inflamed living tissues will be very painful. In applying this test of vitality, therefore, care must be taken to use only such means as shall act upon the particular tissue or part of the body under investigation.

(2) **Arrest of circulation** is another constant sign of gangrene. It is evidenced by absence of all arterial pulsation, by arrest of flow in the superficial veins, as proved by pressure on the cardiac side not causing them to become distended, by the very slow return of the blood to capillaries from which it has been expressed by pressure, or by the failure of pressure to deprive the discoloured tissues of their colour, and by the bloodlessness of an incision into or prick of such dead tissues. This arrest of circulation is one of the chief immediate causes of gangrene.

(3) **Fall of temperature** necessarily ensues upon arrest of circulation, and is one of the signs useful in determining the onset of gangrene. If no means be taken to heat it artificially a gangrenous part falls to the temperature of the surrounding medium. Coldness is not of itself diagnostic of gangrene; some persons who habitually have cold extremities, on exposure to cold may suffer from extreme coldness and numbness of the fingers or toes, which yet recover perfectly.

greater softness and vascularity of the tubercles; its much slower and less destructive course, and the absence of scattered tubercles around the patch, as well as by the different associated affections.

A chronic ulcer situated in a firm tubercle, deep, with a punched-out appearance, with other firm tubercles scattered around, occurring in an adult, with signs or a history of constitutional syphilis (and usually such ulcers are not the sole manifestations of syphilis present), is a *syphilitic ulcer*, the ulcerating syphilide or tubercle.

An ulcer occurring in a person at or past middle life, commencing in a wart or fissure, steadily progressing, with an indurated everted edge, and indurated uneven base, covered with firm pink granulations with yellow specks, with enlargement of the neighbouring gland or glands, which become adherent to the surrounding tissues as they enlarge, is an *epitheliomatous ulcer*. These ulcers are most common on the lips, tongue, penis, scrotum, vulva, and anus, around old sinuses, or in old scars. They are very rarely multiple. The age of the patient, the progressive character of the affection, the infiltrating enlargement of the lymphatic gland are eminently characteristic. If the surface be scraped, and the scraping examined microscopically, large quantities of epithelial cells are found, and perhaps an epithelial "globe," or "nest," may be detected. (*See* page 273.)

The second group of ulcers includes

Traumatic.
Varicose.
Strumous.
Syphilitic.

An ulcer occurring in a healthy individual, and in healthy tissues, as the result of an injury, is a *traumatic ulcer*. Injury often enters into the production of other ulcers, especially the so-called "varicose" ulcers.

A chronic ulcer situated on the lower half of the leg, or about either malleolus, with depressed base, smooth or covered with a few scattered ill-formed granulations or a thin greenish or grey slough, with thickened adherent edge, indurated, congested and adherent surrounding skin, with enlargement of the superficial veins of the limb, is a *varicose ulcer.* These ulcers often originate in some trifling injury inflicted on thickened ill-nourished skin, and their direct dependence upon varicosity of the veins as apart from other vascular disturbances is very problematical. They occur most often in women at and after middle life, and among the poorer classes.

An ulcer with pink or livid undermined edge, with weak flabby granulations covering the base, and thin purulent discharge, occurring in a child or young person of strumous habit, with enlarged glands or other evidence of that diathesis, is a *strumous ulcer.* These ulcers are most common over lymphatic glands in the neck or elsewhere, or over joints. They commence as abscesses, and a history of the bursting of a collection of pus, the thin undermined edge, and the general condition of the patient are their chief distinguishing features.

Syphilitic ulcers have many characteristic features, one or more of which may be present in any given case.

(1) *Number.*—They are often, but not always, multiple.

(2) *Position.*—They may occur in any situation; if on the leg they are not limited to the lower half, and are more common on the outer than the inner side, and are very frequent about the knee.

(3) *Shape.* — Circular or oval, or irregularly sinuous from the coalescence of adjacent sores; most characteristic is an ulcer healing at one edge and spreading at the other, or an annular sore.

(4) *Character.*—A "punched-out" appearance; or a base covered with a tough yellowish grey, "wet washleather-like" slough; or dark conical adherent crusts; or a base covered with very thick and firm mottled grey and pink granulation tissue; or phagedæna, are all characteristic. Syphilitic ulcers may assume all the characters of "chronic ulcers." The healthy condition of the surrounding tissues is a noteworthy feature of the deep and perhaps chronic ulcers of the leg.

(5) *Origin.*—In an induration, or a gummatous infiltration.

The diagnosis of ulcers of the genital organs is given in chapters xxxvii., xxxviii., xxxix.

CHAPTER XXI.

DIAGNOSIS OF SINUS AND FISTULA.

"A LONG narrow suppurating canal" is a *sinus*, and if the sinus communicate with a mucous, synovial, or serous cavity, and give exit to the secretions of these cavities, it is a *fistula*. An unnatural direct communication between two adjacent mucous surfaces is also called a *fistula*. The diagnosis of a sinus is established by the passage of a probe along it, but the size and character of its aperture, and the amount of discharge which flows from it, or the special means by which that discharge can be made to flow, are other signs by which they can generally be recognised. A sinus being recognised, the surgeon must first decide whether it is a fistula by noticing the character of the discharge, and also whether a probe passed along it enters a mucous, synovial, or serous cavity. *Salivary fistula, branchial fistula, urinary fistula, fæcal fistula,* *anal fistula*, and *urachal fistula*, which are thus diagnosed, are referred to in subsequent chapters. (*See* index.) *Recto-vesical fistula* (*see* page 545) is recognised by the passage of fæces and flatus with the urine, and sometimes by the escape of urine from the anus. *Recto-vaginal* and *vesico-vaginal fistulæ* are diagnosed by the passage of fæces or urine from the vagina, and also by direct inspection of the part; where urine dribbles continually into the vagina the fistula opens into the bladder, where it only flow into the vagina during the act of micturition, the fistula opens into the urethra beyond the internal sphincter. A direct communication between the mouth and nose (*oro-nasal fistula*), whether congenital, traumatic, or syphilitic, is rarely, if ever, called by this name. A *pleural fistula*, which is more commonly spoken of as a *fistulous empyema*, is known by the history, the abundant escape of pus, often the passage of air into and out of the cavity with respiration, and the freedom and extent with which a probe can be passed. (For *Wound of pleura, see* page 136.)

The surgeon having diagnosed a **sinus** must investigate it thoroughly, to ascertain if possible its cause. He should enquire into the history of the case, and examine the neighbouring bones and joints for any evidence of disease, and then with a probe, or, if the patient be anæsthetised, with his finger, he should explore it thoroughly, searching for *foreign bodies*, such as bullets and pieces of clothing, for *exposed bone*, and ascertaining the direction, length, and extent of the sinus. *Necrosis* and *caries* are very common causes and accompaniments of sinus; in necrosis the granulations at the orifice are often pale, flabby, and somewhat fungating, the careful passage of the probe causes neither pain nor hæmorrhage, and the exposed bone is felt to be firm, often smooth, and gives a clear sound *on being tapped.*

In *caries* the granulations of the sinus are more vascular, the passage of the probe is painful, and is attended with some hæmorrhage, while the bone is felt to be soft, irregular, and yields a grating sensation, and not a clear ringing sound when tapped; these distinctive characters are only observed in typical cases. If neither of these causes for the sinus be found the surgeon must see whether the cavity *drains* efficiently, as retention of discharge is a very common cause of non-healing; in other cases he will find the sinus runs between muscles or other structures which are constantly being *moved* over each other, and rest, with fixation of the part, is the condition necessary to healing. Associated with any of the above causes of sinus, or alone, the surgeon may find an unhealthy condition of the *lining of the cavity* and the surrounding tissues, and a *strumous* habit of body. The examination of a sinus, therefore, consists first in the investigation of local conditions, *i.e.* foreign bodies, disease of bones and joints, passage of any of the fluids of the body, imperfect drainage, movement of the parts around, atonic condition of the lining membrane, and then of the constitutional state of the patient.

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(3) **Fall of temperature** necessarily ensues upon arrest of circulation, and is one of the signs useful in determining the onset of gangrene. If no means be taken to heat it artificially a gangrenous part falls to the temperature of the surrounding medium. Coldness is not of itself diagnostic of gangrene; some persons who habitually have cold extremities, on exposure to cold may suffer from extreme coldness and numbness of the fingers or *toes, which* yet recover perfectly.

(4) **Loss of function.**—Muscles lose all power of contraction, glands cease to secrete, and so forth; a gangrenous part is therefore immobile, but while continuous with living tissues may be moved by them; thus in a dead foot no contraction of the intrinsic muscles can occur, but the toes may be moved by the long flexors and extensors, the vitality of whose contractile parts in the leg is unaffected. The skin of gangrenous parts is not bathed in sweat, and while the cuticle is preserved intact is dry. Similarly in gangrenous wounds there is an entire absence of all efforts at repair; a gangrenous flap is never united by coagulated lymph, or covered with granulations.

(5) **Change in colour.**—This varies. The part may at first be blanched and bloodless, or intensely congested; in the one case it becomes shrivelled, dry, and brown in colour, in the other black with patches of brown or green, and the formation of discoloured blebs containing bubbles of gas. The superficial vessels are usually first marked out by brownish-red branching streaks. The colour depends upon the amount of blood in the part, and its change upon the diffusion of the hæmatin staining all the tissues, and its subsequent decomposition. Sloughs of subcutaneous tissue are usually of an ash-grey or pale yellow colour, as seen in carbuncle; a sloughing gumma is of the same hue.

(6) **Post-mortem changes.**—In some cases these consist in desiccation, all the dead tissues becoming dry and hard; more frequently they consist in decomposition, characterised by liquefaction of the tissues, separation of the cuticle, the formation of blebs, the evolution of gas in the tissues, giving rise to emphysematous crackling and to bubbles in the blebs, and a putrid odour; in the case of gangrene of the lung the putrid odour of the breath is of great diagnostic value.

(7) **Spontaneous separation from the living tissues** by a line of ulceration is a later and absolutely certain sign of the death of the separated portion. Similar separation of living tissues never occurs. Small areas of dead tissue when protected from decomposition by asepticity are separated by a process of absorption, with a gradual replacement of the slough by living tissue.

B. **Two varieties of gangrene** have been generally recognised, called *dry* and *moist*, and great stress has been laid upon the distinctions between them. There are many cases, however, in which their distinctive features are not present, which are spoken of as *mixed.* The variations depend exclusively upon the relative proportions of fluid in the dead tissues; where this is little the gangrene is "*dry*," where great it is "*moist*," and where intermediate in amount, or varying at different places, or able to evaporate rapidly at one part and not at another, the gangrene is "*mixed.*"

(1) If the dead tissues become shrivelled, hard, dry, of a dark brown or black colour, with little or no odour, it is spoken of as a case of *mummification* or *dry gangrene.*

(2) If, on the other hand, the dead parts are sodden, mottled grey, black, or green in colour, with desquamation of the cuticle, the formation of blebs containing brown-red fluid and gas, and the evolution of gas in the tissues (giving rise to emphysematous crackling or the presence of bubbles along the line of the superficial vessels), and if a dirty ichorous fluid exude from the exposed cutis or from any wounded surface, while the whole part has a penetrating putrid odour, it is a case of *moist gangrene.*

(3) If in one part of the gangrenous mass the tissues are mummified, and at another they are moist *and decomposing*; or if they are neither mummified

nor undergoing the rapid decomposition characteristic of cases of well-marked moist gangrene, the case should be spoken of as one of *mixed gangrene.*

Many morbid processes may lead up to and terminate in gangrene, of which the following are the most frequent, and the best ascertained:

(1) Injury,	(3) Arrest of the circulation,
(2) Inflammation,	(4) Trophic lesions.

(1) **Injury** may lead to gangrene in one of several ways.

(*a*) It may by severe crushing of the tissues destroy their vitality, and arrest all circulation in the part; (*b*) or by mere compression it may arrest circulation in the tissues, as in the case of gangrene from improperly applied splints; (*c*) by the destructive action of intense cold, heat, or caustics; (*d*) by arrest of the circulation through the main vessels it may cause gangrene of the parts beyond, *e.g.* rupture or wound of an artery, or compression of the subclavian vein by a fragment of broken clavicle. In these four classes of cases the injury alone by its direct effect causes gangrene; and while in the first three the injured tissues die, in the last it is rather the tissues at a distance from or beyond the injury that necrose. In other cases injury leads less directly to gangrene. (*e*) When inflicted upon tissues of greatly depressed vitality, in which the circulation is very languid and difficult, quite a trivial injury or the natural effort for its repair, may be sufficient to turn the scale on the side of local death; in this way many cases of senile gangrene arise; the gangrene is not limited to the precise parts injured; (*f*) an injury not severe enough to destroy may yet so diminish the vitality of a part, that an attack of inflammation of insufficient intensity to cause sloughing of previously *healthy* parts, may prove fatal to the injured tissues; illustrations of this may be met with during the repair of contused wounds, and they enforce the importance of guarding against all inflammation in such wounds; (*g*) a wound may be the starting point of morbid processes which lead on to gangrene, quite apart from the original injury, such as spreading thrombosis, septic inflammation, phlegmonous erysipelas, hospital gangrene and malignant pustule or charbon, the poisons of which gain entrance through the wound, or only act when there is a breach of surface. In these three classes of cases injury alone does not lead to gangrene, and the accessory causes are the most important.

(2) **Inflammation,** when intense, may induce gangrene by strangulation of the vessels of a part, aided perhaps by the direct lethal influence of inflammation upon all tissue elements; examples are afforded by acute osteomyelitis, phlegmonous erysipelas, furuncle, and carbuncle.

(3) **Arrest of circulation,** however produced, causes the death of a part; as a primary change and cause of gangrene it is seen in arterial thrombosis and embolism, strangulation of parts, Raynaud's disease, sloughing gumma, and possibly also in gangrene from ergot.

(4) **Trophic lesions,** in cases of damage of the central nervous system, is a cause of rapid and deep sloughing, sometimes witnessed in hemiplegia and paraplegia. (*See* page 104.)

Cases of gangrene may be divided into two classes, *primary* and *secondary.* In the former there is direct and more or less immediate death of tissues, the preliminary symptoms being only those indicating a lessened vitality of the part, coldness, numbness, sense of weight, etc.; in the latter case the death of the tissues is preceded by acute inflammation, with its usual phenomena, and the gangrene is caused by the intensity of the inflammation.

Primary gangrene may be "dry" or "moist"; it is distinguished by a more or less abrupt origin, by the obvious death of the part being immediate, as in a case of burn, or preceded only by pain and numbness, lividity and coldness; subsequent to the death of the part the tissues in its immediate neighbourhood become inflamed, and constitutional symptoms arise.

Secondary gangrene is always "moist," and is distinguished by the acute inflammation, with redness, swelling, heat, and pain, with constitutional disturbance preceding the gangrene; beyond the gangrenous tissues there is a wide area of acute inflammation.

The gangrene is primary.—It may be

(1) Spontaneous. | (2) Traumatic.

The history will at once determine this point.

(1) **Spontaneous primary gangrene** may be

(*a*) Arterial thrombosis, or embolism.
(*b*) Senile gangrene.
(*c*) Trophic gangrene.
(*d*) Raynaud's gangrene.
(*e*) Diabetic gangrene.

(*a*) If a patient be suddenly attacked with severe pain in a limb (most often the leg) and the part be found cold, anæsthetic, slightly livid, with no pulsation in the arteries, and the part then undergo the changes characteristic of "dry" or "mixed" gangrene, constitutional symptoms not coming on until the lapse of a few days, when the line of separation has formed, it is a case of *gangrene from arterial thrombosis or embolism.* This variety is met with during convalescence from acute illness, especially typhoid fever, and in the subjects of heart disease. In cause, symptoms, and course, it exactly resembles gangrene following the ligature or rupture of a main artery. Affecting quite small areas of tissue, it is sometimes seen as the starting point of a chronic ulcer of the leg.

(*b*) If in an old person with tortuous rigid arteries, a weak heart, and a feeble circulation, shown by coldness of extremities, a dry scaly condition of the skin, and sometimes by œdema, a patch of gangrene appear on the toes, foot, or leg, or on the fingers, either spontaneously or subsequent to some very trivial injury, and is then not limited to the exact seat of the injury, it is *senile gangrene*. It is characteristic of this form of gangrene for all the changes associated with it to progress very slowly, for the gangrene to spread or to recur, and for the ulcers left on the separation of the sphacelus to heal very slowly, or to fail to heal altogether.

(*c*) The accompanying paralytic phenomena, and the rapid formation of the sloughs, characterise *trophic gangrene* occurring in paraplegia and hemiplegia. It is the tissues which are exposed to pressure that die, but their rate of death is quite out of proportion to the amount of the pressure to which they are exposed. Gangrene plays some part in what are usually spoken of as the trophic ulcers of locomotor ataxy and leprosy.

(*d*) Gangrene occurring spontaneously in the hands or the feet, and occasionally in other parts, in patients who are subject to attacks of local ischæmia characterised by lividity, coldness, and a certain amount of pain, lasting from a few minutes to hours, or even longer, and sometimes accompanied or associated with attacks of intermittent hæmatinuria, is the *gangrene of Raynaud's disease*. This disease is met with in children and young persons as well as in adults, and the attacks are most frequent or perhaps limited to the winter months of the year. The distinct attacks of local ischæmia and their frequent repetition are very characteristic signs of this disease.

(*e*) *Diabetic gangrene* has local characters closely resembling senile gangrene, and the diagnosis is only established by the detection of sugar in the urine, and the symptoms characteristic of diabetes mellitus.

(2) **Traumatic primary gangrene** may be

(*a*) Local.	(*b*) Spreading.

(*a*) If the gangrene immediately follow the injury, and be limited to the parts injured or to the parts on the distal side of the injury, and if the gangrene do not spread beyond the area which at once dies, it is *local traumatic gangrene.* Of this we may mention several varieties. (α) That due to crushing and bruising of tissues, or to the undue pressure of splints; (β) that due to the effects of cold ("frost-bite"), burns, scalds, and caustics; (γ) that caused by tight bandaging or constriction by some other means, "moist" in variety, and characterised by a deep depression, in which the constricting band lay, marking its upper limit; (δ) that caused by rupture of the main artery of a limb in which gangrene of the parts beyond the injury comes on; (ε) that due to ligature of a main artery.

(*b*) If after an injury in a person with a very feeble circulation from cardiac or pulmonary mischief or general debility, the injured limb become cold, numb, and swelled, and then quickly change to a green or leaden hue, with all the evidences of total death of the part, and this condition rapidly spread up to tissues not immediately affected by the injury, while there is an entire absence of all inflammatory phenomena preceding the gangrene, the case is one of *spreading traumatic gangrene*, from *venous thrombosis.* It is distinguished from the traumatic gangrene due to direct injury of blood-vessels, by its not coming on immediately after the injury, by its rapidly spreading up along the limb towards the trunk to an extent quite independent of the original lesion, and by the concomitant signs of a generally enfeebled circulation.

It has been mentioned that *senile gangrene* may follow a slight injury, but this form of gangrene is readily distinguished from the above forms of traumatic gangrene by the great chronicity of the process, and by the age and the general condition of the circulatory organs of the patients; it is also generally of the "dry" variety.

Secondary gangrene is met with in many forms, but only two will be considered here; they are

(1) Acute septic gangrene. | (2) Hospital gangrene.

The diagnosis of its other forms, whitlow, cellulitis, carbuncle, etc., is elsewhere considered.

(1) If after an injury, which may be as trivial as a prick, or more severe, there be rapid swelling of the part, quickly spreading up towards the trunk, with redness, severe pain and heat, along with marked constitutional disturbance, often ushered in by a rigor and characterised by high fever, rapid pulse and marked general depression; and if this intense local inflammation be quickly succeeded by "moist" gangrene of the part, with rapid decomposition, which may spread up towards the trunk with fearful rapidity, the constitutional symptoms assuming still more of the "typhoid" type, the disease is *acute septic gangrene.* Following a severe injury, this is sometimes spoken of as *spreading traumatic gangrene;* but as it is distinctly secondary to septic inflammation it must be clearly distinguished from that dependent upon general enfeeblement of the circulation and consequent venous thrombosis; the two resemble each other only in their rapidity of occurrence, and in the fact that the gangrene spreads to tissues unaffected by the original injury.

(2) **Hospital gangrene** is now happily a very rare disease, only met with in over-crowded, badly-appointed military hospitals. It is a very contagious disease, and when it makes its appearance it quickly affects and kills large numbers of the wounded. It may assume two forms, the *acute* and the *chronic*, and either may develop at any time during the course and progress of a wound.

(*a*) If a patient the subject of a wound, who perhaps has been progressing satisfactorily, become restless, with a severe tight frontal headache, and complain of a dull, heavy, smarting pain in the wounded part, which in a few hours is found much swelled, with its edges and surfaces firm and looking like boiled pork, and quickly becoming converted into soft pultaceous slough, the constitutional signs meanwhile assuming a grave "typhoid" type, the disease is *acute hospital gangrene.*

(*b*) But if, with similar or less marked constitutional symptoms, the wound break down, enlarge, assume a circular crateriform appearance, the edge being thickened and indurated, and the whole surface covered with a soft slough, the tissues beyond being inflamed, it is *chronic or ulcerative hospital gangrene.*

Gangrenous affections of the face.

(1) Charbon, or malignant pustule.
(2) Carbuncle, or malignant carbuncle.
(3) Cancrum oris.

(1) *Charbon* is met with in butchers, farriers, shepherds, curriers, or persons who have been in contact with animals suffering from "splenic fever," or with their hides or hoofs. It is characterised by the formation of a vesicle containing dark serum, the base of which forms a dry slough, while around it fresh vesicles form in a few hours, and the slough extends, and at the same time the parts beneath become swollen

and hard, and the skin around livid in colour, there being but little pain and an entire absence of suppuration. If the serum of the vesicles, or of the infiltrated tissue be examined, the bacilli characteristic of splenic fever will be detected. Constitutional symptoms (rigors, headache, depression, a rapid weak pulse, dyspnœa, and collapse) usually come on two or three days after the local signs.

(2) If the affection commence with a small vesicle or pustule, around which firm, extensive œdema of the lip, cheek, nose, or eyelid comes on, which increases and becomes of a livid colour, with the development of fresh pustules and the appearance of sloughs of cellular tissue at the bottom of the pustules, the swelling being attended with very severe pain and febrile symptoms of asthenic character (hot skin, rapid weak pulse, dry tongue, muttering delirium), the disease is *facial* or *malignant carbuncle.* Death is usually preceded by signs of pyæmia, and the plugged facial vein may be felt as a firm cord. Some cases of facial carbuncle do not assume this malignant type.

(3) Gangrene attacking a young child, and beginning as a livid, firm swelling of the gums, or of the mucous surface of the lips or cheeks, on which a grey slough appears, and extends to all the tissues of the part, there being meanwhile a discharge of very fœtid saliva and symptoms of nervous depression, is *cancrum oris.* It is most usually met with in debilitated children, and particularly after the occurrence of measles, or other acute specific disease. It is limited to children, and is frequently fatal. It is to be remarked, that in cancrum oris, the sloughing commences on the mucous surface, and spreads outwards; in charbon it begins in the skin and spreads inwards; in carbuncle it begins in the subcutaneous tissue and spreads out to the skin.

It may happen that a carbuncle in a late stage, but before the separation of its slough, may rather closely resemble a sloughing gumma; it may be well, therefore, to point out the features by which the two affections may be distinguished. A *sloughing gumma* is a chronic affection commencing in a painless induration, the skin over which slowly ulcerates in one aperture, exposing the slough, which is usually of a yellowish colour; the area of redness around is very slight and narrow. There are other evidences of the syphilitic diathesis; gummata often occur where carbuncles never occur, as in muscular tissue, or around the knee joint. A *carbuncle* is a much more acute and painful affection, commencing as a red, tender, brawny infiltration, the skin over which ulcerates in several parts, exposing a grey slough, which some believe to have a distinctive odour. Carbuncles are most common on the back of the trunk, and in men past middle life.

CHAPTER XXIII.

THE DIAGNOSIS OF DISEASES OF JOINTS AND BURSÆ.

It will be convenient to consider, in the first place, the general principles of diagnosis of articular disease, and then afterwards to refer in detail, where that is necessary, to the diagnosis of affections of individual joints. It is well to indicate at the outset that among joint diseases will be considered not only those affecting the joint cavities with their synovial membranes, ligaments, and cartilages, but also those of the joint ends of the bones; in discussing these we shall have occasion to point out how affections of neighbouring structures, *e.g.* bursæ, may be identified.

In other words, in this chapter an attempt will be made to enable the reader to examine intelligently and purposively, and then to arrive at a correct diagnosis of, any disease of a joint or its immediately surrounding structures; of a "joint" in the popular sense of the term.

A. When such a case presents itself to the surgeon the first fact to be ascertained is whether there is any organic disease of the part, for it must ever be borne in mind that *hysteria* or *neuromimesis* often imitates closely grave articular lesions. The fact upon which such a diagnosis of *hysteria* must rest is the want of correlation of the symptoms; hysteria is more common in women, but not limited to them, or to any age; it is frequently associated with other signs of hysteria, and in many cases may be traced to the influence of some strong emotional disturbance. Where, then, a patient complains of pain in a joint of a very severe character, especially if this be accompanied with marked superficial hyperæsthesia, but there be no discoloration nor heat nor swelling about the part, nor wasting of the muscles of the limb, an *hysterical joint* must be suspected; and if it be found that the joint is held rigid, usually in the position assumed in disease, but sometimes strikingly different, as *e.g.* in the position of extreme extension, and that all attempts to move it excite spasms of the muscles and cries from the patient, but that when the attention is diverted passive movement can be made without difficulty or pain, or that the patient herself moves the part, this suspicion becomes converted into a positive diagnosis. In cases where the surgeon remains in doubt the history of some strong emotion or the witnessing of a case of real joint disease just before the onset of the illness, or the presence of other hysterical phenomena, will be of assistance; and it may be useful to place the patient under the influence of chloroform and to examine then with care the outline and mobility of the joint, and particularly to notice when the joint becomes rigid, for it is stated that in neuromimesis the rigidity only reappears when the patient's consciousness returns, while in painful organic disease it comes on as soon as the deep anæsthesia passes off. Slight ill-defined general swelling may be met with as the result of the use of stimulating liniments; and in some cases of long-standing, slight wasting of the muscles may be observed, but this is never so marked as in cases of organic disease.

Having determined that there is organic disease of the part, the surgeon must next ask himself where that disease is situated, and *what structures are involved.* This is mainly determined by the position and outline of any swelling present, the character and degree of interference with the function of the joint, and the seat, character, and mode of causation of pain. Where swellings are found which correspond in outline to some neighbouring structure as a bursa or synovial sheath, and not to the articular cavity or any of its bones, and if at the same time there is no alteration in the mobility of the joint or pain produced by it unless it excite it in the inflamed structure outside, it will be at once known that the disease is extra-articular; such cases are constantly seen in housemaid's knee, miner's elbow, teno-synovitis of the wrist or ankle, etc. On the other hand, where a swelling does correspond in outline to the synovial cavity of a joint, or to one of the articular bones, or where the motion of a joint has lost its smoothness, or is painful, or the articular bones are found sensitive to pressure or shocks transmitted through them, it may be judged that the actual joint structures are involved. We must now consider this matter a little more fully. Owing to the frequency of diseases of the synovial membrane, it is best, in the first place, to examine that structure, and then the cartilages, ligaments, and the articular bones, and, lastly, the structures around the joint.

(1) Where the outline of the swelling corresponds to the synovial cavity, or gentle even movement of the joint is painful, the disease may be considered to be affecting the *synovial membrane.*

(2) Where the articulation always assumes one particular position, any alteration of which is painful and is resisted, or where the natural relation of the bones is seriously altered, as in subluxation backwards of the knee, or the outline of the synovial cavity is altered; or, again, where abnormal mobility is possible, the disease has affected the *ligaments* of the joint; in some cases a consideration of the symptoms will enable the surgeon to localise the lesion in a particular ligament.

(3) Where the movement of the joint has lost its usual smoothness and is accompanied by hard grating or a soft rubbing or a crackling sensation, or where the patient experiences severe "starting pains" in the part, especially just as he is falling off to sleep, or, again, where nodular growths can be felt springing from the edge of the articulated cartilage, the disease is known to be affecting the *cartilage.*

(4) If the articular bone or bones be found swelled, and tender on pressure, and if pain be excited by force transmitted along them, or if the patient complain of a deep aching or gnawing pain in the part, worse at night, it will be known that the *articular bone* is diseased.

(5) If a swelling correspond in position and outline to a bursal cavity, or there be soft friction felt on movement of the walls of a bursa over one another, while the neighbouring joint is at rest, it will be evident that the disease is in a bursa.

(6) And where a swelling corresponds in position or outline to a tendinous synovial sheath, or pain and

soft grating are elicited by movement of a particular muscle or muscles, while the joint is kept at rest (where this is possible) the diagnosis of disease of a *synovial sheath* is obvious.

(7) Lastly, a swelling or other morbid phenomenon may not correspond with any special structure, but may involve the common connective tissue of the part.

Many joint diseases affect more than one of the above structures, either primarily or in succession, and in the latter case it may be impossible to tell where the disease originated; but wherever it is possible, and certainly in all cases early in the disease, a careful attempt to localise the affection will usually be attended with success.

B. The surgeon must next determine the *nature of the affection* present. Inflammation in its various forms is the most frequent disease, and its symptoms are like those observed in other situations. Degenerations and neoplasms are also met with.

THE DISEASE IS ACUTE,

(1) If, immediately after a severe strain or wrench, or following a fracture into a joint, the synovial cavity be found distended and fluctuating, and especially if the skin show any signs of bruising or blood-staining, and be not hot, nor the joint acutely tender, the diagnosis of *hæmarthrus*, or effusion of blood into the synovial cavity, should be made. Unless the case is seen early this diagnosis cannot be attempted, as it is only by the time of occurrence of the swelling that we are able to distinguish with certainty between effusions of blood and of serum, and in many cases the one is followed by and associated with the other.

(2) If the synovial cavity of a joint be found distended with fluid which has been secreted rapidly, and the part be hot and tender, with perhaps slight redness of the skin, while the patient complains of constant

throbbing pain, any movement of the joint causing acute pain, the general temperature being also raised, the disease will be recognised as *acute synovitis.*

(3) If the symptoms continue, and the swelling increase, the superficial structures become œdematous, and the skin assume a dull red colour, the local heat is more marked, and the general pyrexia increases, and especially if there be a rigor, *pyarthrus*, or pus in the joint is to be diagnosed. As there is no sharp line between the usual inflammatory effusion and pus we are unable to mark the precise onset of suppuration; wherever the symptoms lead the surgeon to suspect it, he should resort to exploratory puncture and an examination of the contents of the joint. This may be repeated from day to day if necessary.

(4) Where a similar distension of the synovial membrane with fluid is found, but there is no redness, and little or no heat of the skin, and no tenderness, while the pain in the part and on moving it is less marked, and there is no general fever, but the disease is of recent origin, it will be distinguished as *subacute synovitis.*

(5) If a synovial effusion develop very rapidly, and quickly run on to suppuration with destruction of the articular cartilage as shown by the presence of bony grating on moving the joint, and this be accompanied by high fever and a rigor or rigors, the diagnosis of *pyæmic synovitis* may be arrived at. This will be confirmed by the other signs of pyæmia (*see* page 67), by the fact that several joints are successively affected, by the comparative painlessness of the affection, and the presence of a bright red blush over the joint.

(6) If several joints are simultaneously or successively attacked with moderate, general, ill-defined swelling, acute pain especially on any movement, moderate tenderness of the joint and superficial heat

and redness, and if there be acute pyrexia, profuse sour-smelling perspiration, concentrated acid urine, a coated tongue, and particularly if there be pericarditis, endocarditis or pleurisy, or a history of previous attacks, the surgeon will recognise the joint affection as a part of *acute articular rheumatism.* The number of joints affected, the rapid onset and subsidence of the local lesions, the character of the general disturbance, and the history of previous attacks are the main points on which to found a diagnosis.

(7) If a joint or joints become inflamed after either of the acute specific fevers, or during the course of an attack of gonorrhœa or gleet, the part being swelled, hot, very painful, and the general temperature raised, it is regarded as a form of *subacute pyæmia.* That associated with gonorrhœa is known as *gonorrhœal rheumatism,* it may attack one or many joints, and other than articular synovial membranes.

(8) If a patient be seized in the night with a very severe pain in a joint which in a few hours becomes swelled, with a red glossy appearance of the skin over it, and œdema of the subcutaneous tissue, the part being exquisitely tender, and the temperature moderately raised, it will be recognised as *acute gout.* This diagnosis will be confirmed if the affected joint be the metatarso-phalangeal, if previous similar attacks have occurred and particularly in that joint, and if there be other evidences of gout such as tophi, dyspepsia, cramps, family history, or by a demonstration of excess of uric acid in the blood.

(9) If the joint end of a bone of an infant or young child become acutely swelled, painful, and very tender, the soft parts over it being swollen, but careful movement of the joint is found not to give acute pain; and further, if fluctuation be subsequently detected close to, but not in, the synovial cavity, or the epiphysis of the bone be found movable upon the

diaphysis, the disease is *acute epiphysitis;* inquiry must then be directed towards obtaining a history of a blow, or of congenital syphilis.

If there be a fluctuating swelling in the position of a bursa, with great pain, tenderness and redness of the skin and general pyrexia, it may be diagnosed as *acute bursitis;* and if the surrounding tissues become œdematous, the pain throbbing in character and the temperature still more raised and variable during the day, it indicates that *suppuration* has occurred. This affection is most frequently seen in the bursa over the patella, or in that over the olecranon or in a bunion, generally as the result of a wound or some other injury.

If the patient complain of sharp pricking pain in the site of a bursa, and it be found tender on pressure and yielding soft crepitus or friction when the part is so pressed or moved as to glide the two surfaces of the bursa over one another, it is to be recognised as *subacute plastic or dry bursitis.* This is seen most often and is most readily diagnosed in the prepatellar bursa.

THE DISEASE IS CHRONIC.

(1) Where the synovial cavity is found distended with fluid, and the part is neither reddened, hot, nor painful, the only subjective symptoms being a sense of weakness, and some limitation of movement, and if this be a very chronic affection it is known as *hydrarthrus* or dropsy of the joint.

(2) Where there is a small amount of fluid in the synovial cavity, and this part is found to be somewhat thickened, and the limitation of the movement of the joint is more than is accounted for by the amount of effusion, while there is no local heat, redness, or tenderness, it is known as *simple chronic synovitis.*

(3) If there is found an ill-defined elastic swelling of a joint, giving it a more or less even globular

outline, and if there be some heat of skin, but no redness, and the part be rigidly fixed, in a position of semiflexion usually, and any movement be resisted and is painful, and pressure over the articular ends of the bones or of the two bones against each other is painful, while the muscles of the part are flabby and wasted, the patient being pale, anæmic and showing perhaps other evidences of struma, the disease is *chronic strumous arthritis* or *white swelling* of the joint. There may be softening or fluctuating parts of the swelling, or sinuses leading down to carious or necrosed bone, or the pains pointing to ulceration of cartilage, or the grating sensation on moving the joint characteristic of exposure of the joint ends of the bones; all these but confirm the diagnosis. This disease may originate in the synovial membrane or in the epiphyses; it may affect the various structures of the joint to very different degrees, and progress very slowly or more rapidly, and towards recovery or towards destruction of the articulation. Hence the actual phenomena of the disease differ considerably in a series of cases. The signs by which it may be decided whether the disease, if commencing, is attacking the synovial membrane or the epiphyses of the bones have been stated above (page 356).

(4) If a joint slowly and almost painlessly become enlarged and stiffened, and on examination there be found a brawny ill-defined thickening of the ligaments and the soft parts over the joint, with firm nodular projections which can be felt as such moving over the cartilages almost like loose bodies, and especially if there be any ulceration of this indurated tissue, or cicatrices of old syphilitic ulcers, or a history or other evidence of syphilis congenital or acquired, the disease is *syphilitic gummatous arthritis.* When the infiltration is well marked there is usually considerable synovial effusion. Pains in

joints between the appearance of an indurated chancre and the secondary eruption may be attributed to syphilis. And synovial effusion appearing in a joint without any injury during the secondary stage of syphilis is also to be recognised as *syphilitic synovitis.*

(5) If a patient generally about or past middle life complain of more or less constant wearing aching pain, and of some stiffness or a sense of weakness and insecurity in a joint, these symptoms being usually worse in cold damp weather, but not sufficiently so for the disease to be called intermittent or to consist of successive attacks, and on examination the surgeon detect dry creaking or crackling on passive movement, and firm nodular outgrowths from the edge of the joint surfaces, he will diagnose *arthritis deformans.* This disease may occur in young delicate persons; it may attack one or many joints, thus it is often limited to one hip or knee, or is seen involving many of the small joints of the hands, where the nodular outgrowths from the bones are very evident. Occasionally joints affected with this disease break down and suppurate, the soft parts become swelled and boggy with dusky redness of the skin over them, and an abscess bursts discharging cheesy or curdy material. A disease closely simulating if not identical with this has been described by Charcot as occurring in locomotor ataxy and is now known as *Charcot's disease of joints* or *ataxic arthropathy.* There is usually considerable effusion, rapid and great absorption of the articular bones, no or very little growth of osteophytes, and singular freedom from pain; the onset of the disease is more acute and its course is usually more rapid than is that of common arthritis deformans. The absence of the patellar reflex, the occurrence of lightning pains in the limbs, the failure of the pupil to contract under the

stimulus of light while it contracts when the eyes converge, and the characteristic gait, will enable these cases to be recognised; "gastric crises" are common in the patients with this disease.

(6) If the patient have experienced several attacks of acute pain, tenderness and swelling of a joint or joints, and the part be found permanently enlarged with a smooth or nodular deposit around it, either fixed to the bones or movable over them, and the joint be found either anchylosed or moving without creaking or grating, and especially if this disease be hereditary, have occurred solely or first in the joints of the great toe, or the heel or ankle, and if there be other signs of gout as tophi, rigid arteries, dyspepsia, with excess of uric acid in the blood, it is *chronic gout.* The position of the disease, its onset by successive acute or subacute attacks, the character of the "chalk-stones" and the other evidences of gout distinguish this from arthritis deformans; it is much more common in men than women.

(7) For the diagnosis of sarcoma of epiphyses of bones *see* page 317. A soft sarcoma springing from a bone may burst through into the synovial cavity and fill it out, and so simulate synovitis; the diagnosis will rest upon the swelling not being limited to the joint cavity, by its constant growth, and by a puncture yielding only blood; later on by ulceration of the skin, fungus, etc.

(8) If, during movement of a joint, it become locked in the flexed position, with intense sickening pain, the presence of a *loose body in the joint* must be suspected; and if the attacks recur from time to time, while under some sudden passive movement both the pain and the immobility abruptly pass off, and particularly if the "body" can be felt moving within the synovial cavity, the diagnosis becomes certain. In some cases the "loose body" is felt by the patient and

the surgeon, and the diagnosis is made previous to its slipping between the bone and causing the severe pain. If the "body" be always found at the same part of the joint, and cannot be moved freely to all parts of the cavity, it may be considered as still attached by a pedicle of synovial membrane.

A fluctuating tumour occupying the position of a bursa, with no local heat or redness of the skin, and but slight pain, and no tenderness or pyrexia, is to be diagnosed as *chronic serous bursitis.*

If at the site of a bursa a small firm rounded or oval nodular body can be felt, movable under the skin and over the subjacent bone, it may be diagnosed as a *pendulous growth in the bursa.* These can be diagnosed when they occur in the prepatellar bursa.

A tense globular fluctuating cyst, not adherent to the skin, but found to be adherent to a synovial sheath, or to a joint, or to be reducible into a joint by gentle continuous pressure, is a *synovial cyst.* These are most common over the back of the hand and dorsum of the foot; but they are also met with in connection with other joints and synovial membranes.

C. In this section will be considered the special features of the diseases of individual joints. For *disease of the temporo-maxillary joint, see* chapter xxviii.

(1) **Shoulder joint.**—Owing to the deep position of the joint, distension of its synovial cavity does not give rise to a fluctuating swelling, and only in some cases can a soft elastic or fluctuating protrusion be felt in the axilla; but in *acute synovitis* the joint is held fixed, and the prominence of the shoulder is somewhat increased. In *dropsy* of this joint the arm may be lengthened, and the head of the humerus can be pushed up into its proper place, and then felt to fall again.

Where the prominence of the shoulder is considerably increased, and fluctuation is detected through the deltoid muscle, or from its anterior to its posterior border, while the joint is not fixed, nor its movement painful provided that the limb is kept abducted to relax the deltoid muscle, the surgeon will diagnose *effusion into the bursa beneath the deltoid.*

(2) **Elbow joint.**—Distension of the synovial cavity is most apparent on the outer side of the olecranon and over the head of the radius; sometimes it causes the obliteration of the space between the olecranon and the inner condyle of the humerus, or bulging above the olecranon.

The ease with which each of the three bones entering into this joint can be felt renders the detection of disease limited to one or other of them comparatively easy. The only *bursa* in this situation liable to be inflamed is one placed over the tip of the olecranon under the skin; effusion into it causes a swelling in the middle line of the joint behind, obscuring the olecranon, instead of on each side of that bone as in synovitis.

For disease of the *wrist joint*, *see* chapter xliii.

The hip.—The hip joint lies so deep and is so well protected by thick masses of muscle that the outline of its capsule cannot be defined, and distension of its synovial cavity causes nothing more than a slight ill-defined fulness in the fold of the groin, and occasionally in very thin subjects a soft or even fluctuating swelling behind the great trochanter of the femur. The limb is at the same time held flexed, abducted and rotated out. The diagnosis of disease of the hip and of the affections for which it may be mistaken is a matter of great importance, and must be considered in some detail.

The patient should always be examined lying flat on his back, on a firm mattress, with the lower limbs extended, and care should be taken to have the pelvis straight, so that a line between the two anterior superior iliac spines crosses at right angles a line drawn from the xiphoid cartilage to the symphysis pubis. The surgeon should then notice whether, when the spine is resting its whole length upon the mattress, the suspected limb can also be placed straight down; if not, it indicates that the joint is flexed, and this is a most important sign of disease. When the joint is flexed to even a marked extent the thigh can still be placed straight down by tilting the spine into a position of lordosis; when this is marked the hollow under the back is readily recognised; but in order to detect any slight degree of flexion, and also to measure its amount, the surgeon should grasp the knee of the sound limb and raise the thigh until it lies with its whole length along the front of the trunk (until the hip joint is fully flexed), the spine will then be extended along the mattress; if now the suspected limb still lies flat along the couch there is no permanent flexion of the joint; if on the other hand, as the spine is by this manœuvre extended, the diseased limb rises, the vertical height of the knee above the mattress is a measure of the amount of flexion of the hip joint. Flexion is the most constant and the most important deformity observed in inflammation of the hip, but it is also observed in cases of ilio-psoas abscess and effusion into the bursa beneath the psoas; it is not a feature of sacro-iliac disease, unless it be complicated with ilio-psoas abscess. The parallelism or the reverse of the limb to its fellow should then be noted; normally the thighs are inclined slightly inwards, and rather more so in women than in men; abduction of the thigh is seen in the early stages of morbus coxæ, and only occasionally later, and in cases of synovitis; adduction is found in the later stages of morbus coxæ, and becomes exaggerated when the head of the femur is dislocated on to the dorsum ilii. At the same time the surgeon will notice whether the limb is rotated in or out; eversion is seen when the synovial cavity is distended as in simple synovitis or the early stage of morbus coxæ commencing in the synovial membrane, and in any condition leading to tension of the ilio-psoas muscle, such as abscess in its sheath or in the bursa beneath it; inversion is found in the later stages of morbus coxæ, and is most marked when the femur is dislocated. The mutual relations of the bony prominences of the hip should then be ascertained by comparative measurement on the two sides. (*See* page 203.) The great trochanter may be raised to a slight extent by absorption of its neck or flattening of its head, by separation of the upper epiphysis of the femur, or to a more marked extent by dislocation of the femur on to the dorsum ilii. Approximation of the trochanter to the median line may be caused by absorption of the neck or head of the bone, and by displacement of the femur through the acetabulum into the pelvis; on the other hand, undue prominence of the trochanter is caused by dorsal dislocation of the bone. While recording these absolute measurements of the parts the surgeon should not fail to notice the apparent relative length of the two limbs as observed when they are both stretched out straight upon the mattress; apparent shortening, far in excess of, or indeed in the absence of real shortening, is frequently seen in morbus coxæ; while apparent lengthening of the limb is a characteristic sign of sacro-iliac disease; in each case alike it is due to tilting of the pelvis. The mobility or rigidity of the joint should then be tested. For this the left hand should be placed firmly upon the outer surface of the pelvis, and the right hand grasping the knee should first make gentle and then more forcible attempts to flex and extend, abduct and adduct, or rotate the thigh. Care [illegible] The surgeon should note then whether the pelvis [illegible] whether there is any [illegible]; secondly, whether [illegible]; thirdly, whether, when the joint is [illegible], rotary and lateral movement [illegible], free, and smooth; fourthly, whether movement is attended with any [illegible], or rough grating or crepitus. Rigidity of the joint may be due to two conditions, [illegible] spasm, and in the latter case it points to [illegible] inflammation. When movement of the joint is painful and limited, but on full flexion the rigidity and pain in moving the thigh pass off it indicates that there is spasm of the iliopsoas muscle and careful examination should be made for abscess in its sheath, or between it and the capsule of the joint. If all rigidity pass off under chloroform it is proved to be entirely muscular. In connection with this symptom notice the tension of the adductor tendons and of the sartorius, and also turn the patient on to his face and compare the fulness of the two buttocks and the level of the gluteal fold on each side; a lowering of the gluteal fold is a sign of wasting of the gluteal muscles.

The surgeon should then examine into the condition of the bones. The outline of the trochanter should first be compared on the two sides, and then the palm of the hand being placed flat on the trochanter, firm and gradually increasing pressure should be made in the line of the neck of the bone; if this elicit signs of pain it indicates tenderness to pressure and inflammation of the neck or head of the femur; this sign should not be elicited by sudden blows upon the trochanter or upon the heel; in children the mere blow may cause them to cry, and in all patients alike unnecessary pain may be caused, and when the heel is struck the position of the tender part cannot be precisely localised. The head of the bone may be felt in the buttock or the extreme shortening, adduction and rotation of the thigh together with a marked hollow in the groin indicate dislocation of the femur. Then the surgeon should place one hand on the front of each iliac crest and attempt to press these two bones asunder or together, and to compress the pelvis laterally; by this means some slight movement is occasioned between the ilium and sacrum, and by the occurrence or non-occurrence of pain referred to that joint, it may be inferred that the joint is or is not diseased. Any swelling of the part should be carefully investigated; there may be simply indistinct fulness in the groin, or swelling of the inguinal glands, or a fluctuating collection of fluid. If the latter, care should be taken to notice whether it corresponds in position with the bursa under the psoas muscle beneath and below Poupart's ligament, or with the sheath of the iliacus or psoas, or the bursa over the great trochanter of the femur, or is occupying the planes of cellular tissue of the part. A fluctuating swelling bulging above Poupart's ligament, just internal to the iliac crest, not reaching into the thigh at all, or quite to the outer side of the femoral vessels, is an *iliac abscess*. A fluctuating swelling pointing above the middle of Poupart's ligament, and extending into the thigh behind the femoral vessels to their inner side, is a *psoas abscess*. An abscess pointing above the brim of the pelvis is probably connected with disease of the acetabulum. Pain in the knee, especially at the inner side of the joint, may be the chief or the only spontaneous pain complained of in hip-joint disease. In sacro-iliac disease pain may be referred to the branches of the great sciatic or of the anterior crural nerve.

In cases where the limb is apparently lengthened, while the hip joint can be fully extended, and there is no rigidity or pain in moving this joint, whereas there is tenderness over the sacro-iliac joint, with pain on pressing the two innominate bones together or asunder, the surgeon may diagnose *sacro-iliac disease.* This is a disease of adult life, it comes on insidiously, the patients complaining of lameness, weakness and pain in the back and along either the sciatic or anterior crural nerve. Look for iliac abscess, which may cause flexion of the hip, but neither rigidity nor pain in moving it, and for abscess in the buttock or in the pelvis bursting into the rectum.

If the hip joint can be moved without pain in all directions, and to the full extent, and no pain be caused by firm pressure along the neck of the bone, the hip joint and the articular bones may be regarded as free from active disease. When there is pain in pressing along the neck of the bone, and a limp in walking, and the joint is flexed and rigid, *epiphysitis of the femur* may be diagnosed. When there is marked rigidity of the joint in the flexed, abducted, and everted position, and great pain on any movement of the part, but pressing the great trochanter does not excite pain, *synovitis of the hip joint* is to be diagnosed. With increased flexion, adduction, and rotation in, the advance of the disease to the ligaments and bones may be recognised, or dislocation of the bone may be verified. Disease of the pelvic part of the articulation may be suspected when abscess is found coming up from the inner surface of the pelvis to the brim, and pointing at the groin; or where a probe passed along a sinus strikes necrosed bone which does not move when the thigh is rotated; this sign may, however, be caused by separation of the head of the femur, but in that case the surgeon will notice that the trochanter turns upon its own axis, or round a much smaller circle than on the sound side.

Inability to extend the thigh, and pain in attempting to do so, together with a fluctuating swelling deep in the groin, but freedom of flexion of the joint, and when the joint is flexed, absence of all rigidity, and smoothness of motion of the femur in the acetabulum, are the signs whereby we can recognise *effusion into the bursa under the psoas.* This may be met with as a complication of morbus coxæ. Where a *psoas abscess* is present the spine must be carefully examined for evidence of caries, especially the lower dorsal region, failing that, the pleural cavity and the kidney of the same side should be examined. Where an *iliac abscess* is found, its cause should be sought for in disease of the lumbar spine, of the sacro-iliac joint, or of the ilium, or in inflammation around the cæcum or sigmoid flexure.

Knee joint.—This joint should always be examined with the limb extended. The synovial membrane extends on each side of the patella and above it; when distended it gives a smooth elastic fluctuating swelling in this position, and it floats the patella forwards away from the femur upon which it normally rests; when this bone is pressed upon at right angles to its surface, it is felt to yield and presently to tap against the femur; this is what is known as the "floating of the patella." This is an extremely important sign of effusion into the joint, as it is obtained when the amount of fluid is too small to yield either fluctuation or decided swelling. To obtain it, it is important that the knee be extended, the hip flexed, and the triceps muscle relaxed. The limb should be examined resting upon a couch; the surgeon should then grasp the thigh just above the knee with his left hand, and gently but firmly draw the soft parts down to relax the rectus, and to make sure of this he should note whether the patella is freely movable from side to side; he should then with the tips of two or three fingers of the right hand press the bone directly back, and if he feel it yield under the pressure, and then strike against the femur, the patella "floats;" unless there is something in the joint raising the patella, it always lies on the femur in every position. Unless these precautions are taken, the surgeon may be deceived in trying to elicit this sign; thus if the bone be pressed obliquely or laterally it may be so moved on the femur as to simulate the tap of the "floating" patella; while if the amount of fluid be small or moderate, and the rectus be contracted, the bone may be pressed back on the femur by that muscle, or held so firmly that this symptom is not elicited. This is a constant sign of fluid in the knee joint, and the only other condition causing it is the presence of a very soft neoplasm in the joint; the writer recently had an opportunity of observing this, and was for a time misled by it as to the nature of the case.

In all acute and subacute inflammations of the joint it assumes a position of moderate flexion, with rotation out of the tibia, and if the head of the tibia become displaced backwards on the femur it shows that the hamstring muscles are spasmodically contracted, and that the crucial and lateral ligaments have yielded to their traction; this displacement, therefore, is an important sign of the implication of the ligaments in disease.

Excessive lateral motion in the joint is sometimes seen as the result of stretching of the ligaments in hydrarthrosis. Tenderness over the attachments of the internal lateral ligament is not uncommon after acute synovitis.

The bones are so subcutaneous that their condition can be well investigated; it may be useful to point out that the patella may be alone involved in acute or chronic inflammation ending in either necrosis or caries.

Loose bodies are more frequent, and more usually occasion acute and characteristic symptoms in the knee than in any other joint. The joint is also liable to *displacement of a semilunar cartilage*, giving rise to fixity of the joint and severe pain, coming on during some quick movement of the joint, and often followed by an attack of subacute synovitis; these symptoms are the same as those met with in "loose bodies" in the joint, and the diagnosis of the case depends upon noticing that the seat of pain is always over one or other semilunar cartilage, that at the time some projection of the cartilage may be felt, or possibly a depression if it be displaced inwards, and that no "loose body" can be felt in the joint; the pain is not so great in displacement of a meniscus as in impaction of a "loose body."

There are a number of bursæ around the knee joint, the position of which must be remembered.

A swelling over the patella, obscuring that bone, may be diagnosed as involving the *prepatellar bursa*, and is either acute or chronic, serous, suppurative, or plastic; it may assume the form of a globular, firm, unyielding tumour, smooth and rounded externally, not adherent to the skin, and freely movable over the patella; this is *chronic plastic bursitis.*

If there be a rounded tense fluctuating swelling above the patella, but that bone do not "float," and there is no swelling on either side of the patella, or fluctuation across the joint from side to side, it is to be diagnosed as effusion into the *suprapatellar bursa.*

If there be no fluid in the knee joint, but active extension of the joint is painful, and the ligamentum patellæ is prominent with a little swelling on either side of it, with fluctuation across from one side to the other, and especially if pressure upon the ligament causes some pain and a lateral bulging on each side of it, effusion into the *infrapatellar bursa* (or the bursa between the patellar ligament and the upper part of the tubercle of the tibia) may be diagnosed. The fat normally present around this bursa may give a sensation very closely simulating fluctuation and therefore a comparison with the sound knee should be made with every care, and this diagnosis arrived at only when the condition is different on the two sides, and fluctuation is unequivocal.

If a fluid tumour be found on the inner side of the knee beneath the semimembranosus tendon, which becomes full and tense and projects back into the ham when the knee is extended, but much less tense when the joint is bent, it is an effusion into the *bursa between the semimembranosus and the gastrocnemius*, sometimes called the *popliteal bursa;* when the joint is bent the swelling will be plainly felt between these muscles; if the bursa communicate with the joint, it will be reducible on pressure.

A similar swelling over the inner condyle of the tibia, superficial to the semimembranosus tendon, becoming as it enlarges ovoid in shape with its long axis vertical, is an effusion into the *bursa under the sartorius.*

A small tense fluctuating swelling immediately above the head of the fibula bulging backwards towards the ham is an effusion into the *bursa under the biceps.*

In every case of pain in the knee the surgeon should satisfy himself that there is no disease in the hip joint.

Ankle joint.—The bones entering into this joint are so immediately subcutaneous that they can be readily and satisfactorily examined. It is necessary to point out the peculiarities of the swellings produced by effusion into the joint and into the tendinous sheaths and the bursa around the joint, and also the peculiarities of the pain met with in these different affections. *Effusion into the ankle joint* causes some fulness in the front of the joint beneath the extensor tendons, but particularly a rounded fluctuating swelling below and partly around each malleolus which gives an appearance of increased width to the joint which is very characteristic when seen from the back; there may be distinct fluctuation from one of these lateral swellings to the other.

Effusion into the sheath of the tibialis posticus tendon causes an elongated fluctuating swelling behind and below the inner malleolus reaching two inches or so above its tip, and extending downwards into the sole at the instep. The swelling is longer and reaches higher up than that caused by effusion into the ankle joint, and is usually not accompanied by swelling around the outer malleolus. *Effusion into the peroneal sheath* causes a similar swelling behind the outer malleolus, and reaching down below it over the os calcis; this is not so common as the former. *Effusion into the bursa beneath the tendo Achillis* causes a swelling above the point of the heel under the tendon, with fluctuation from side to side. Care must be taken in this observation, as the soft fat beneath the tendon may give a sensation which may be readily mistaken for fluctuation. Characteristic creaking and soft grating may be detected in these synovial sheaths and bursa on moving the parts. The pain of disease of the ankle joint must be distinguished in the first place from that of disease of the tarsal joints, and then from that of disease of these synovial sheaths and bursa. For this purpose the heel and instep should be grasped close to the ankle joint and moved on the leg; if this elicit pain it excludes tarsal disease. If now, while the ankle is fixed, the foot be everted and inverted, the tibial and peroneal tendons will be alternately put on the stretch, and if pain be produced in either movement it will indicate the sheaths of these tendons as the seat of the mischief. In inflammation of the bursa behind the os calcis, there is pain when the patient points his toes and contracts his calf muscles, and when the surgeon raises the toes and stretches the tendon of these muscles, not when the toes are passively pointed. The pain of inflammation of the synovial membrane is elicited by every movement of the joint. The position of tenderness is also of use as indicating the seat of disease.

For *disease of the tarsal joints, see* chapter xliv.

ANCHYLOSIS.

When a patient presents a stiff joint the surgeon has to determine whether the anchylosis is *true* or *false*, and if the latter whether it is *intra-articular* or *extra-articular*, and the nature of the *disease leading to it.* Premising that *true anchylosis* is of much rarer occurrence than *false*, and that therefore every case is to be considered *false* until demonstrated to be *true*, we will endeavour to point out how these problems are to be solved in any given case.

Nature of the anchylosis.—In some cases motion at the affected joint is at once obvious, and the following remarks apply only to those in which there is apparent immobility at a joint. (*a*) Notice whether there is pain during either active or passive attempts to move the joint; if there is, it indicates the absence of *true anchylosis.* (*b*) Next notice the condition of the muscles which act upon the joint in question; if they are found spasmodically contracted, or if on attempting to move the joint they become tense, it shows that the anchylosis is *false;* great wasting and entire relaxation of the muscles is a useful sign of *true anchylosis.* (*c*) Notice whether there is any yielding of the joint to passive movements, or whether, on the contrary, the limb feels solid; to render the diagnosis certain, ether or chloroform should be given to full narcosis, and careful attempts then made to obtain movement. If the limb feel quite solid when manipulated, and if attempts at movement do not cause pain or spasm of muscles around the joint, and if during complete unconsciousness there be no movement obtained in the joint, it may be pronounced to be a case of *true anchylosis.* Where, on the other hand, some movement or yielding of the joint is obtained, or the attempt causes pain or muscular spasm, the *anchylosis is false.*

To determine the *variety of the false anchylosis* is in many cases a more difficult matter. The history of the case should, of course, be carefully investigated, and the joint examined with a view of finding evidence of affection of the bones (enlargement or adherent cicatrices) or of the synovial membranes, or matting together of the tendons around the joint. The signs of old sinuses are important, as they usually, but not invariably, indicate intra-articular disease. If, then, the stiffening have followed upon a severe burn or destructive inflammation of the soft parts, or upon a fracture not extending to the joints; or if there be evident thickening of the soft parts, matting together or immobility of one or more tendons around the joint, and there be no deformity in the joint, no enlargement of the bones, and if any movement that is possible be smooth and even, the *adhesions* are *extra-articular.* Where, on the other hand, there is a history of inflammation of the joint itself, or of wound or fracture extending into it; or the joint is deformed, the bones enlarged, and the soft parts marked with scars of old sinuses, the *adhesions are intra-articular.* In some cases these two varieties are combined, or the diagnosis between them may be impossible.

The diagnosis of the *nature of the disease* inducing the anchylosis presents no special points that require to be discussed here; the history of the case and the nature of the changes in the part will lead to a correct judgment on the point. There are, however, some practical points in relation to some of the individual joints which require notice.

Anchylosis of the lower jaw is very rarely true; its diagnosis is difficult, and absolutely necessitates the administration of an anæsthetic; it often depends upon cicatrices in the mouth. (*See* page 391.)

Anchylosis of the shoulder is very common, but is almost invariably *false*, and is very often *extra-articular*. Owing to the extreme mobility of the scapula, and the large share it takes in the angular movements of the arm, the patient, and even an incautious surgeon, may be misled as to the degree of stiffness present. To test the point, the surgeon should rotate the arm with one hand, while the other rests firmly on, and fixes the scapula. As the scapula takes no share in this movement, any rotation that is possible must be at the humero-scapular joint; the rotation must not be violent, especially when a joint has long been stiff, or it may cause fracture of the neck of the humerus.

Anchylosis of the elbow is more often true. It only needs to point out that flexion and extension may be seriously limited by plastic material or bone filling up the coronoid or olecranon fossæ, or by outgrowths from the coronoid or olecranon processes; the radio-ulnar joint participates in intra-articular anchylosis of the elbow. In cases of sudden limitation of flexion of the joint at a right-angle be careful to ascertain that the head of the radius is not displaced forwards.

Anchylosis of the wrist is most frequently *extra-articular*, caused by adhesion of the tendons in their sheaths; this is known by the accompanying limitation of the movements of the fingers and thumb, parts quite at a distance from the original injury or disease.

Anchylosis of the digits is most often due to *whitlow* and tendinous adhesions, or to *arthritis deformans.*

Anchylosis of the hip may be due to *arthritis deformans,* but is more often the result of *strumous arthritis.* Care must be taken to fix the hip bone by firm pressure while attempting passive or active movements, for where the joint is rigid the normal movement at the lumbar spine becomes increased; as in the shoulder, rotation movements are the most reliable.

Anchylosis of the knee.—The patella is the most convenient bone to examine for mobility; if it can be moved laterally to any degree it shows that it is not ossified to the femur, and this is very strong evidence that the anchylosis between the tibia and femur is also *false.* Subluxation of the tibia backwards, or rotation of the bone outwards, or marked flexion of the joint, are strong evidence of intra-articular disease.

Anchylosis of the ankle is very often *extra-articular,* being frequently seen after fractures near the joint, or in bad sprains. When it is of long standing and complete, the tarsal joints become unusually mobile.

Anchylosis of the tarsus is most often *intra-articular* and *true.* It may exist on the outer side of the foot in connection with old standing talipes varus. In the joint of the great toe it is usually due to gout.

Anchylosis of the spine and ribs is mentioned on page 395.

CHAPTER XXIV.

DIAGNOSIS OF DISEASES OF THE HEAD.

In chapter v. the diagnosis of the injuries of the head and their sequelæ is discussed, and we must refer the reader to that chapter for information on the subject of hæmatoma, hernia cerebri, pulsating collections of blood or cerebro-spinal fluid under the scalp, erysipelas, and cellulitis. In this chapter we shall consider only those affections of the scalp, pericranium, and vault of the skull, which are not traumatic in origin. Of these, the most important for diagnosis are the various tumours here met with, and they will accordingly be considered first.

A. **Tumours of the head.**—The surgeon should first of all inquire whether the tumour was *noticed at birth* or soon after, or at a later period; the congenital tumours of the head are hæmatoma (*see* page 77), meningocele, encephalocele, nævus, and dermoid cyst; the last two are often not observed until shortly after birth; those developing later in life are nodes, cysts, exostosis, sarcoma, and epithelioma. The next fact to be ascertained, and this is the most important of all, is whether the tumour *communicates with the cavity of the cranium*, and of this there are five signs: *fixity to the bone*, *reducibility*, *pulsation*, the detection of an *aperture in the skull*, and the existence of *cerebral symptoms.* Tumours which are not fixed to the skull are certainly not intracranial; but many extracranial tumours are fixed to the bone. Try whether the tumour is partially or wholly *reducible* by gentle pressure; if it be, it is either a protrusion of the cranial contents or a vascular tumour, and if after reduction the skull be felt entire beneath it, it is certainly the latter. A solid tumour communicating with the cavity of the skull is quite irreducible. *Pulsation* is a sign common to some collections of blood or cerebro-spinal fluid under the scalp (*see* page 82) to hernia cerebri (page 96), and also to aneurism by anastomosis, encephalocele, and pulsating tumours of the bone or dura mater. If the pulsation be stopped by compression of the arteries of the scalp, it is certainly an extracranial tumour. If controlling these arteries has no effect upon the pulsation, it shows that it is due to the throbbing of intracranial or cranial vessels. In some cases an *aperture in the skull* may be plainly felt, or the finger may detect a depression in the bone around the base of the swelling. The presence of *cerebral symptoms*, convulsions, paralysis, or coma, is strong evidence of the intracranial nature of a tumour, but many tumours communicating with the interior of the skull are unattended with such signs. As a result of his examination, then, the surgeon may be able to declare some tumours certainly extracranial, others certainly intracranial, and of others it may be impossible to assert whether they communicate with the cranial cavity or not. The surgeon should then note whether the tumour is *solid* or *fluid*, *single* or *multiple*, *adherent to the skin* or allowing that structure to move over it, its *shape*, and the characters of any *ulceration* associated with it, its rate and mode of *growth*, *tenderness*, etc. Having completed this examination, he should be able to arrive at a diagnosis as follows:

(1) If a congenital tumour be found adherent to the bone, fluctuating, reducible by gentle pressure with or without the production of cerebral symptoms, and if the bone be felt to be deficient at its base, it is a *meningocele*. These tumours are usually globular in shape; they are most often met with over the occipital protuberance, at the root of the nose, or along the vertex. If tapped, cerebro-spinal fluid escapes. (*See* page 83.) Meningocele is often associated with hydrocephalus.

(2) If a congenital tumour with the general characters of a meningocele be found to pulsate synchronously with the temporal artery, it is known to contain some portion of the brain, and to be a *meningo-encephalocele*. In these cases pulsation may only be detected when the tumour is partially reduced,

as in a case lately under the author's care. The movements of the brain with respiration may be detected, as well as arterial pulsation.

(3) The diagnosis of a cutaneous nævus is obvious. But if a flat soft tumour, which was noticed at or soon after birth, be found beneath healthy or nævoid skin, and if it yield under gentle pressure, becoming fuller and tenser when the child cries or strains, it is a *subcutaneous nævus.*

(4) If the tumour pulsate forcibly, if it be uneven on the surface, evidently consisting of convoluted vessels, through which the firm bone of the skull can be felt, and if large arteries can be traced in the scalp to the edge of the tumour, compression of which stops the pulse in the tumour, it is a *cirsoid aneurism.* The skin over these tumours is usually hot, and there are no cerebral symptoms. (*See also* page 302.)

(5) If a non-congenital solid tumour of the skull, which is immovably fixed to the bone and pulsates with an expansile beat, be quite incompressible and irreducible, and if its pulsation be unaffected by compression of the arteries of the scalp, it is a *pulsating sarcoma of the cranium.* The appearance of the tumour may be preceded by severe local pain; it may grow with varying rapidity, and may exhibit the pulsation in places only; sometimes the sign of "egg-shell crackling" is perceived, which makes the diagnosis quite easy. If there are cerebral symptoms, it is to be inferred that the tumour is intracranial; the absence of such signs is no proof to the contrary. Some of these tumours have been described as "fungus of the dura mater."

(6) If the tumour be globular, tense, smooth, and fluctuating, irreducible and devoid of pulsation, it is a *cyst.* Of these, three forms are known, only two of which can be diagnosed. If the tumour be acquired, adherent to the skin, and freely movable over the

bone, it is a *sebaceous cyst.* These are often multiple, are commoner in middle and late life, and they may attain a large size, or become inflamed and ulcerate. If the scalp move over the tumour, and if the latter be partially fixed to the bone, not being freely movable over it, it is a *dermoid cyst.* These may be found at birth or may be only noticed later on, and they are more common in young people. They are most often found near the outer angle of the orbit. They are generally single. Before removing them, the surgeon should examine carefully the bone beneath them, as they are often placed over a depression or even a hole in the skull. A *meningocele,* the pedicle of which has become occluded, could not be diagnosed with certainty from the above, unless it were tapped and the fluid examined. If the tumour were of large size at birth, the surgeon should suspect meningocele, and tap the tumour to clear up the diagnosis.

(7) If, in an infant, low rounded firm swellings of the bone are found grouped around the anterior fontanelle, but not extending quite up to it, they are the "natiform swellings" of Parrot, and are due to *congenital syphilis;* the surgeon should examine carefully for *craniotabes,* and also for other manifestations of this inherited taint.

(8) When, in later life, low, smooth, or uneven swellings of the bone are found, which are painful and tender, firm or fluctuating, they are to be diagnosed as *syphilitic nodes.* These vary much in their condition. In some the pain and tenderness are extreme. Some are hard and bony, others softer, and others again fluid. They may be single or multiple. Little pits in the bone may be felt between elevated ridges; in other cases the skin is ulcerated, and gummatous material or sequestra are exposed. They are favourably influenced by treatment, and are associated with other evidence of syphilis.

(9) A prominent, clearly circumscribed tumour fixed to the bone, of absolute hardness, of very slow growth, or stationary, and quite uninfluenced by any treatment is an *exostosis*. This may be accompanied by cerebral symptoms indicating that the tumour is partly intracranial. Such a tumour may be cast off as a sequestrum.

(10) A circumscribed tumour fixed to the skull, solid, firm, irreducible by pressure, and of steady growth, is to be diagnosed as a *sarcoma* of the bone. These tumours vary in their rate of growth ; they may exhibit "egg-shell crackling" at some part of the surface which will greatly facilitate the diagnosis. If there are cerebral symptoms it must be inferred that the tumour is partly intracranial.

(11) If there be an ulcer of the scalp with thick everted edges, and a dirty sloughy or fungating base discharging very foul-smelling fluid, careful inquiry must be made as to its mode of origin. If it be found that it began as a chronic globular tumour which became inflamed and burst, and especially if there be sebaceous cysts in the scalp, or the connected lymphatic glands are not enlarged, it is to be recognised as an *ulcerated sebaceous cyst*. Such an ulcer may easily be mistaken for a malignant sore.

(12) If, on the other hand, it be found that the ulcer began as a small wart or crack, which gradually extended, and the edge be firm and adherent to the pericranium or bone, and if the lymphatic glands at the angle of the jaw or behind the ear and sterno-mastoid be enlarged and hard, it is to be diagnosed as an *epithelioma of the scalp*.

B. Of the remaining affections of the head little need be said. In infants, the skull should be examined for *craniotabes* and for signs of *rickets*. If any part of the skull (not a fontanelle or suture) be found to yield under the finger, having the resistance of parchment rather than of bone, the condition is known as *craniotabes.* Such softened spots are most often found in the parietal bone behind the parietal eminence; they are generally associated with congenital syphilis, but may be due to rickets.

If the head be found flattened behind with the forehead prominent, and the fontanelle widely open or open too long, and the bones are thickened along the sutures, it may be described as a *rickety skull.* The anterior fontanelle should not be palpable after twelve months of age.

When the head of an infant or young child is found to be disproportionately large and continually increasing in size, with wide separation of the cranial bones and perhaps distinct fluctuation perceptible from suture to suture, it will be at once recognised as a case of *hydrocephalus.* It has been said that if the disease be congenital, and the eyes be prominent owing to depression of the roof of the orbit, it is *hydrocephalus interna;* but if the disease come on after birth, and especially if the eyes be unaffected and there be a history of injury, it is *hydrocephalus externa.* This distinction is of little, if any, practical value.

The detection of the crusts or scabs of *eczema impetiginodes* of the scalp, or of "nits" or mature *pediculi,* which should be sought among the roots of the hairs, will at once establish a diagnosis.

If an adult find that he constantly has to get a larger hat, or by other signs a general increase in the size of the skull is verified, the affection will be recognised as *hypertrophy of the skull.* If at the same time, or subsequently, the long bones of the extremities become enlarged and curved, and the stature diminished, the disease will be recognised as *osteitis deformans.* This is a very chronic affection attacking persons past middle life. (*See* page 315.) If there be an ulcer of the scalp, and at its base hard dry rough bone be felt and seen, the case is one of *necrosis;* and if the disease be spontaneous and chronic, and the bone be found pitted and uneven on the surface, it is *syphilitic* disease of the cranium. This diagnosis will be corroborated by finding nodes on the skull or other evidences of this dyscrasia. The surgeon must be careful to distinguish mere exposure of the cranium from its necrosis. By wounds or cellulitis portions of bone are often exposed, smooth, hard and dry, but after a time the bone may be seen to be pink in colour and then gradually granulations sprout through its surface and the wound heals over. It is only when this does not take place, but on the contrary the surgeon has evidence of the separation of a sequestrum in the formation of a groove around the exposed bone, or by its black colour, and the length of time it remains without undergoing the above change, that he must diagnose it as dead. When, however, the surgeon has rough diseased bare bone exposed in an ulcer, the disease having originated in the bone, the diagnosis of necrosis is clear from the beginning.

When the side of the head above the ear is swelled, hot, reddened, acutely painful and tender, and tight closure of the jaws or wide opening of the mouth is painful, *abscess beneath the temporal fascia* is to be suspected. If the surgeon detect fluctuation the diagnosis is certain. As an abscess in this region demands early opening, it will be well, in the absence of fluctuation, to introduce a grooved needle or small syringe to clear up the diagnosis. A high temperature, shivers, and sweating will confirm the suspicion of abscess. The swelling is tense and boggy, and has the limits of the temporal fascia, not extending down on to the face or neck, but there may be œdema of the eyelids on the same side.

CHAPTER XXV.

DIAGNOSIS OF DISEASES OF THE JAWS AND GUMS.

The acute affections of the jaws are inflammatory, and the most frequent is alveolar abscess. Whenever, therefore, a patient presents himself with an acute, painful, and evidently inflammatory swelling of the face, over either jaw bone, the first thing for the surgeon to do is to seek for evidence of alveolar abscess. By gentle pressure let him find the seat of most acute tenderness, and observe whether the swelling is there fixed to the bone; next he should examine the teeth, looking first of all for carious stumps and for pus escaping by an alveolus, and then he should tap each tooth in succession with a small metal hammer to detect whether any one of them is tender to sharp vertical pressure. Passing his finger between the lip and the gum he will feel for swelling over the alveoli. If he find the swelling fixed to bone, and one tooth very tender to pressure, probably also decayed with swelling over its alveolus, he will diagnose *alveolar abscess.* These abscesses may point at some distance from the diseased tooth which gives rise to them. When, however, the swelling is very extensive, especially if it involve the body and ramus of the lower jaw, and there be no evidence of its connection with an individual tooth, or several teeth be found loosened, raised from their sockets and very tender, it must be diagnosed as *acute periostitis.* There is generally high fever in this condition.

An *acutely inflamed gland* below the lower jaw may closely simulate either of the above affections, but it will be found to be movable over the bone, or there will be a history that at the commencement of the swelling it was thus movable.

The chronic affections consist of *necrosis*, *periostitis*, and the various *tumours* of the bones. The most constant evidence of necrosis is the presence of one or more sinuses, and if these are found they must be carefully probed, and if a sequestrum is felt the diagnosis of *necrosis* is to be made. The sequestrum may be either the fang of a tooth or part of the bone; in the former case the sinus is usually single, in the latter case there are often many sinuses and much thickening, or even the development of a bony involucrum around the sequestrum. The surgeon must bear in mind that a sinus in connection with a tooth may open at some distance from the sequestrum, on the face, the neck, the palate, or into the nose. In all these cases, therefore, the teeth must be carefully examined for caries, and for any tenderness, and suspicious teeth should be drawn. But where there is great thickening around the jaw, or the probe leads to the ramus or body of the lower jaw, or a large sequestrum is seen in the mouth, it is *maxillary necrosis.* The most extensive variety of this is *phosphorus necrosis.* (*See* page 392.)

When the surgeon recognises that he has to deal with a tumour of the jaw he should first decide whether it is inflammatory in nature. If the swelling be on one side of the bone only (as on the hard palate, or outer side of the lower jaw) painful and somewhat tender, and the patient be the subject of syphilis, it must be considered as *chronic periostitis;* if the swelling subside under treatment, the diagnosis will be confirmed; if it withstand treatment and continue to enlarge it must be regarded as a neoplasm.

Tumours of the jaws.—From the frequent occurrence of cysts in the jaws the surgeon must first try to decide whether any given tumour is solid or cystic. The outline is to be carefully noted, then fluctuation must be felt for, as well as the yielding of any part of the wall to pressure, with the sensation as of egg-shell crackling or the bending of parchment, and the teeth must be very carefully examined to see whether one of the permanent teeth remains uncut, and this requires the more care, as in such a case the corresponding milk tooth may not be shed. A smooth globular or ovoid outline of a tumour, its slow gradual painless growth in a young person, and the absence of one of the teeth, are strong points in favour of a tumour being *cystic ;* if to these signs there be added fluctuation or "crackling," the diagnosis is certain; but if these signs are absent the surgeon should insert a small trocar, and examine the contents of the swelling; this will at once clear up its nature. If the cyst be single, and the fluid be thick and mucilaginous, containing cholesterine, it is in all probability a *dentigerous cyst*, and the errant tooth must be sought. If, however, the tumour be lobulated, more irregular in outline, it is to be diagnosed as a *multilocular cyst.* These are most common in the lower jaw, and they are often connected with decayed teeth.

Solid tumours are to be distinguished from each other by the same rules as in other situations. (*See* chapters xvi. and xix.) The surgeon will be able to diagnose *osteoma*, *fibroma* (which is a central growth and probably should be grouped as a sarcoma), *periosteal* or *central sarcoma* and *chondro-sarcoma.*

In the upper jaw the relation of a tumour to the **antrum** is a matter of particular interest. The antrum is explored by examining its walls, and if necessary by tapping the cavity with a trocar. Distension of this cavity causes a bulging of its outer wall below the orbit and malar bone, a flattening or depression of the roof of the mouth, a raising of the floor of the orbit, causing protrusion or other displacement of the eye-ball, and, when extreme, blindness, and obstruction in the nasal fossa of the same side with epiphora; the expansion of its cavity may take place especially in one or other of these directions, but it must not be diagnosed unless more than one of its walls is found bulging. Distension of the antrum may be caused by empyema of the antrum (slight), the growth of cysts into the cavity, and especially by solid tumours, bony, sarcomatous and cancerous.

In the case of large tumours the surgeon must endeavour to ascertain whether the tumour is limited to the jaw or involves other bones; he should examine the temporal region, the nose, and the bone over the frontal sinuses, for evidence of swelling, and then, passing his finger behind the soft palate, should feel whether the tumour is filling up the pharynx, or is fixed to the base of the skull.

If the antrum appear slightly distended, and the patient complain of a dull aching pain in the part, and of an unpleasant odour in the nostril of the same side, and bad taste in the mouth in the morning, and if, when he lies down on the opposite side, odourless pus streams from the nostril, the surgeon is to diagnose *empyema of the antrum.* (*See also* page 414.)

When one or other jaw bone, or any of the other facial bones, slowly and progressively enlarges, forming large nodular masses of bone without distinct circumscription, and being quite unmodified by treatment of any kind, the disease is known as *leontiasis.* When advanced, this disease causes the most hideous distortion of the features.

The temporo-maxillary joint. — The most frequent affection of this joint is inability to open the mouth. Where this condition is of acute origin, and attended with severe painful spasms in the muscles closing the jaws, it is acute *spasmodic trismus* or *tetanus.* (*See* page 72.) Where chronic, the surgeon must examine to distinguish between three conditions. Putting his finger in the mouth, he should feel if there are any cicatricial bands uniting the bones, and preventing opening of the mouth; if there be, it is *cicatricial trismus.* If the wisdom teeth be uncut, or misplaced, or the molar teeth crowded too closely together, he will recognise it as *reflex trismus* or *chronic spasmodic trismus.* This is the form most often met with in young persons, otherwise healthy. If the surgeon find neither of these causes for the lockjaw, he must characterise it as *anchylosis*, which may be *true* or *false.*

If the patient complain of pain on movement of the temporo-maxillary joint, and a sensation of grating, which may or may not be perceived by the surgeon, and the condyle be enlarged, the diagnosis of *arthritis deformans* should be made.

Acute arthritis occasionally occurs; it is attended with great pain on mastication, swelling in front of the ear, tenderness, and suppuration, the pus escaping through the auditory meatus, or behind the ramus, or into the mouth. The disease may terminate in necrosis of the condyle, or in anchylosis.

Diseases of the gums.—The gums are swollen, spongy, and livid in *scurvy;* the other symptoms of this disease render the diagnosis easy. If the gums are swelled, and the edge surrounding the necks of the teeth is sloughy, and separated from the teeth, enquire as to whether the patient has been taking mercury, or is exposed to the influence of this metal in any way; where that is so it will be recognised as *mercurial gingivitis;* there will be swelling and perhaps ulceration of the tongue, salivation, loosening of the teeth, a metallic taste in the mouth, and marked fœtor of the breath. Where, however, there is no mercurialism, and aphthous sores are found on the lips or tongue, it will be recognised as *aphthous gingivitis.*

A *sinus* in the gum should be carefully probed, and the adjacent teeth explored, and if the probe lead down to a hard smooth surface it is probably a fang of a tooth. The probe may, however, pass over a more extensive surface of sequestrum, *necrosis of the alveolar process.* If, on looking into the mouth, the surgeon find the gums receded from the teeth, and the teeth loose or fallen out, and if the alveolar process be bare and exposed, with pus welling up alongside it, he will at once diagnose *necrosis.* This may have resulted from injury in tooth extraction (*traumatic*), or have followed one of the exanthemata (*exanthematic*), in which case it affects the alveolar process only, is often symmetrical, and is insidious in its progress; or it may occur in one exposed to the fumes of yellow *phosphorus,* when the necrosis is apt to involve the whole depth of the bone, and to be accompanied with a great amount of swelling, and in the case of the lower jaw the formation of an ossified shell of new bone around the sequestrum. A sequestrum due to phosphorus poisoning is nearly always rough on the surface, and of a dirty brownish colour. Necrosis of the jaws is also seen as the result of *cancrum oris.*

The remaining affections of the gums may be grouped together as *tumours.* The rapidity of growth, attachment, consistence, and tendency to ulcerate are the facts to be particularly observed in such cases.

Where in an infant or young person the gum is found growing up and overlapping the teeth, or even burying them entirely, and projecting in the mouth as irregular lobed masses of firm tissue covered by healthy mucous membrane, it is a case of *hypertrophy of the gum.* This is a congenital affection, though it may not be recognised until some time after birth; it is often associated with hypertrophy of the alveolar process and premature eruption of the teeth.

If there be a small pedunculated growth from the gum attached between two teeth, and covered with healthy mucous membrane, it is a *polypus of the gum.* If the growth be papillated or villous on the surface it is known as a *wart.* Similar warts are sometimes seen on the palate or on the tongue.

If a sessile tumour grow from the gum, being somewhat firmly but not immovably fixed to the alveolus, and it is of slow growth, very firm, painless, and covered by healthy mucous membrane, it is a *fibrous epulis.* When of large size the surface may ulcerate from pressure and friction. This is to be distinguished from a polyp by its deeper and broader attachment, and usually its greater size.

But if the tumour be firmly fixed to the alveolar process, have grown more rapidly, and especially when it has a livid colour, a lobed surface, is of soft consistence, and is found to spring from within an alveolus, it must be diagnosed as a *myeloid epulis.*

When the gum of an elderly person is found ulcerated, the ulcer slowly but steadily spreading in all directions, and having an indurated base and everted edge, it is *epithelioma.* Enlargement of the lymphatic glands will confirm this diagnosis.

A very chronic solid enlargement of an alveolus is probably caused by an *odontome* in connection with the fang of a tooth. *Bulbous odontomes* will be recognised by the white nodular enlargement of the crown of a tooth.

CHAPTER XXVI.

DIAGNOSIS OF DISEASES OF THE SPINE.

THE surgical affections of the spine may be classified into those attended with deformity of the spine, disease of the spine without deformity, and tumours over the spine. The spine should therefore first be examined for deformity, and if none be present, then for disease without deformity, while tumours of the spine require a special study.

A. **Examine the spine for deformity.**—The patient should stand up with heels together, arms hanging, and the eyes directed straight in front; if an infant it must be examined in the sitting posture. The surgeon should first observe the natural antero-posterior curves of the spine, noting whether they are increased or diminished, or replaced by a general curve of the spine backwards, or interrupted by an abrupt projection of one or more spines. He should next determine whether there is any rotation of the vertebræ one upon another. For this purpose the prominence of the angles of the ribs, and of the lumbar transverse processes on the two sides, must be carefully compared, and the height and prominence of the scapulæ, the hollow of the waist on each side, and the apparent prominence of the iliac crest must be noted. Then, turning the patient round, the surgeon should notice whether one breast is more prominent than the other, or either side of the chest is flattened, and if the two anterior iliac spines are on the same level, or one is lower and more prominent than the other. Standing behind the patient the surgeon should then ask him to stoop while keeping the knees straight, and should notice whether he bends the spine freely and straight forwards, or whether the movement is restricted and oblique, and makes the projection of the ribs on one side more obvious than before. All these are signs of rotation of the spine, and it must be impressed upon the student that the diagnosis of scoliosis must depend upon the presence and degree of this rotation and not upon the lateral deviation of the tips of the spinous processes. Having made this examination carefully, the tips of the spines should be traced from above downwards to notice whether they are in line or whether they are deflected to one or other side; the usual and convenient way of doing this is to place an ink mark on the skin over each spine-tip and connect the dots by a continuous line. The patient may then be placed on his face on a flat couch, or suspended by his head and axillæ, and the effect upon the spine of this alteration in position observed.

(1) If the natural curves of the spine are lost, and in their place there is a general convexity of the spine backwards which disappears when the child lies down, and is increased or diminished by movement, it is due to *spinal debility.* In young children this is usually due to rickets, and if the long bones are bent with swellings over their epiphyses, and the fontanelles are found open too late, etc., it is to be diagnosed as a *rachitic spine.* In other cases it is met with in patients convalescing from severe illness which has kept them in the horizontal position for a long time.

(2) But if such a general posterior curve of the spine be a fixed curve, unaltered by recumbency or movement, and if the movements of the spine be greatly diminished or almost *nil,* and the chest be also fixed, the breathing being entirely diaphragmatic, it is due to *spondylitis deformans,* a disease closely resembling, if not identical with, arthritis deformans. This condition is generally attended with severe pain. It may be met with in young adults, but is more frequent in later life. It will be distinguished from caries of the spine by the absence of tenderness to vertical pressure, by the pain being worse at night in many cases, and sometimes by the patient being conscious of a grating in his spine during movement.

(3) If there be an abrupt curve of the spine backwards, or a projection posteriorly of one or more of the spinous processes, and the spine above and below

be found curved forwards in compensation, it is a case of *Pott's disease* or *angular curvature*, or better, *caries of the spine.* Where the projection is great the evidence of fall of the upper part of the spine (such as sinking of the head between the shoulders) is obvious; where the disease is active there will be the signs of spinal caries mentioned below. (*See* page 397.)

(4) Where there is a lessening of the natural curve of the dorsal region, the dorsal spine being straight, and sunk in between the scapulæ, there is rotation of the spine. If the surgeon find that on one side (say the right) the angles of the ribs are more prominent posteriorly than on the other, and that the scapula is higher and more prominent, that the right side of the waist is hollow, and the iliac crest apparently prominent, while on the left side the hollow of the waist is obliterated or less marked, but the transverse processes of the lumbar vertebræ project back, there is rotation of the spine (to the right in the dorsal region, and to the left in the loins), and he should diagnose *scoliosis*, or what is generally known as *lateral curvature* of the spine. As corroboration of this he will look for flattening of the right chest in front, and projection forwards of the left breast and of the left anterior iliac spine, and also lateral deviation of the spinous processes, to the right in the dorsal region, and to the left in the loins. The curves may be found on the opposite sides. If the surgeon rely upon the deviation of the spinous processes instead of upon the evidence of rotation he will fail to diagnose many cases, and will fail to appreciate the gravity of others. The surgeon should then examine the feet, knees, and hips, to detect any cause of inequality of length of the lower extremities which can cause obliquity of the pelvis and tilting of the spine, such as flat foot, genu valgum, or morbus coxæ.

(5) Should the surgeon find that there is lateral deviation of the spines without rotation, and that this deviation disappears when the patient lies down, he should distinguish it as a *weak spine;* this is often associated with *hysteria*, and the patient may complain of acute pain; the lack of permanence in the curve, and the absence of rotation, will distinguish it from true *scoliosis.*

(6) If the spine be curved with a long sweeping curve to one side without rotation of the vertebræ, the curve being permanent in every position, it is due to *retraction* of one side of the chest, probably from *pleurisy or empyema.*

B. Cases present themselves **where there is no deformity** in the spine, and the surgeon has to decide whether there is commencing caries or not, and as it is in this stage of the disease that treatment is eminently important, great attention should be given to the examination. The symptoms of caries of the spine before deformity has arisen, are *pain, tenderness to pressure,* and *rigidity.* The surgeon should first of all *observe the patient's movements,* encouraging him to walk, run, or jump off a stool or chair, pick things up from the floor, etc., and noticing whether these actions are performed easily, readily, and without restraint, or whether the patient tries to avoid all jars, keeps the spine rigid, and endeavours to transmit the weight of the body through the arms, by seizing surrounding objects, by supporting the head with the hands, or by sitting with the hands resting on the seat or the knees. The several parts of the spine can be examined by placing the hand flat on the back, and getting the patient to bend and extend the region, and noticing whether the vertebræ move one upon another, or are immovably fixed. In the cervical spine the movements of nodding the head or rotation of the head and of flexion of the spine, should be separately investigated, as they occur at separate joints. Thus, if nodding the head be free and painless, it shows that the occipito-atloid joint is unaffected; if the face can be turned without difficulty from side to side, it shows that the atlo-axoid joint is free; and if flexion of the spine be quite free and painless, it shows that the lower cervical spine is unaffected; any one of these movements may be impossible, or very limited and painful, and this will point to disease of one or other of these regions. The surgeon must be careful to supplement this observation with an examination of the state of the muscles of the spine; if they are found tonically contracted, forming a firm mass on each side of the spine, it shows that movement of that part of the spine is painful.

Tenderness of the spine may be tested in three ways; first, by pressing with the fingers over the spinous processes. If the patient flinch and show signs of pain the surgeon should notice whether touching the skin very lightly and pinching it up without any pressure on the bone is equally painful. If it is, it indicates simple cutaneous hyperæsthesia, which is an important sign of "hysterical spine." Patients with active inflammation of the bodies of the vertrabæ can often bear firm pressure over the spine. The second plan is to press vertically down through the spine, when, if there be active disease in the bodies, pain will be caused. The patient may be standing or sitting; pressure is best made upon the head, but when the suspected region of the spine is the lumbar, the surgeon may press with his hands upon the shoulders and the top of the chest. At first the pressure should be quite light, but if this fail to elicit pain, it may be gradually increased up to heavy pressure, and if this be borne without any evidence of pain, inflammation of the bodies of the vertebræ is excluded. The third plan is to take a spoon dipped in hot or iced water and press it against the spine, and if it be found at one part to cause wincing or other expression of pain, that region is said to be hyperæsthetic to heat or cold. This sign is of little practical value. *The pain* in disease of the spine may be local, or referred to the extremity of the nerves leaving the diseased part of the spine; such pain may be complained of in the head or at the shoulders, at the epigastrium, or down the legs, and Sayre has particularly pointed out the importance of such pain in children, and the necessity of a careful examination of the spine where a child has headache, cough, or belly-ache.

(1) If the surgeon find that one part of the spine is kept rigid, that attempts to move it cause pain which the patient instinctively avoids, that vertical pressure down the spine also causes pain at the same spot, and that for this reason the patient avoids all vertical jars and shakes and pressure upon the spine, he should diagnose *caries of the spine*, even before there is any angular curvature from destruction of the bodies of the vertebræ. Pain referred to the extremities of the nerves arising from the affected region of the spine, will corroborate the diagnosis.

(2) Where, however, the patient complains of a fixed severe pain in the spine, and the skin of this region is found hypersensitive to pressure, or to heat or to cold, but vertical pressure through the spine is not resented, and the spine is not rigid at the painful part, the disease is *hysteria*. Such cases are usually met with in young women, but are not limited to them; and there may be other hysterical manifestations. The surgeon should endeavour to distract the patient's attention from his examination, when he will probably find that the painful part can be freely manipulated and pressed upon without causing signs of

pain. In these cases, too, the hyperæsthesia is very superficial, being as much shown by the skin as by the subjacent bones. The patients often give a history of an injury.

(3) Where the coccyx or the joint between it and the sacrum is the supposed seat of disease, the part must be examined with some care. If the hand detect heat or swelling, and tenderness over the part, and on introducing the finger into the rectum the least movement of the coccyx is found to cause acute pain, *disease of the sacro-coccygeal joint* is to be diagnosed. This will be confirmed if there be an abscess pointing either on the outer or the inner surface of the bone.

(4) If, however, there be no local redness or heat or swelling, but the coccyx be the seat of severe pain and some tenderness, so that defæcation and examination per rectum are painful, it is to be considered a case of *coccidynia*. This affection is most common in women, and often follows an injury to the part.

(5) In all cases of *caries of the spine* the surgeon should carefully examine for *abscess*, and for evidence of *nerve lesion*. The abscess may be found at the back, but more frequently the pus runs down along the front of the spine. When the disease is in the neck the surgeon should examine the back of the pharynx, the posterior triangle, and the suprasternal notch. In disease of the dorsal spine each psoas muscle should be explored; if no swelling be detected, but either hip be permanently flexed, it indicates inflammation of the muscle (*psoitis*), and suppuration will speedily follow. In disease lower down the abscesses are found in the sheath of the psoas or iliacus, or passing into the pelvis, and pointing at the buttock or the perineum. The examination of a case of caries of the spine, in whatever stage the disease may be, is not complete

unless a careful search be made for abscess connected with it. The signs of nerve lesion are pain and hyperæsthesia, twitchings and paralysis. They are due to inflammation of the nerves, or to compression of nerves or the spinal cord itself, and an attempt should be made to distinguish these conditions. If the patient complain of severe pain along certain nerves, and the painful region be hyperæsthetic, and if to this there be added muscular twitchings, these symptoms may be attributed to *neuritis.* Where there is considerable deformity of the spine, with paralysis of the lower limbs which is lessened or altogether passes off when the patient is suspended by the head or lies prone, it is to be attributed to *compression of the cord.* If, however, the paralysis be limited to the muscles supplied by certain nerves issuing from the diseased part of the spine, it is to be attributed to *compression of nerves.* If the patient suddenly become paralysed without any pain or hyperæsthesia or twitchings, and without any increase in the deformity to explain it, the cause may be diagnosed as a sudden *hæmorrhage* compressing the cord.

(6) When caries of the spine undergoes resolution it becomes necessary to be able to decide whether the disease has subsided, or is still active. The sign upon which the surgeon is to rely is the absence of tenderness of the spine to vertical pressure. When a patient can bear firm and even heavy vertical pressure through the affected part of the spine, and moves freely and without fear, and can run or jump off a stool or chair without any pain, the surgeon may declare him free from active spinal caries. Rigidity may be permanent owing to welding together of the diseased bones. The tests must be applied carefully and gradually, and the surgeon must feel his way to the application of the more crucial ones; if this caution be not observed harm may be done when the disease is not entirely at an end.

C. **Tumours of the spine.**—These are to be separated into the *congenital* and the *acquired.* In examining a *congenital tumour* of the spine, the surgeon must first endeavour to ascertain whether it communicates with the spinal canal and the spinal membranes. For this purpose the following points must be observed: (1) *Position.* A central position is characteristic of all intraspinal tumours, and if a tumour be found not to occupy the median line it is very unlikely that it communicates with the spinal canal. (2) *Condition of the spine.* If a bony rim is to be felt around the sessile base of the tumour it favours its intraspinal nature, whereas if the laminæ and spines are to be traced entire beneath the swelling it shows it to be extraspinal. (3) *Reducibility of the tumour* is a very important sign of its intraspinal origin, especially if the reduction of the tumour leads to increased tension of the fontanelle or to nervous symptoms. (4) *Increased tension of the tumour* during crying or strong expiratory efforts is of similar import; this, however, when unaccompanied by reducibility of the tumour, may be due to proximity of the swelling to the rectum, or other abdominal viscera. (5) *Complications.* Of these the most important are hydrocephalus, club-foot, paralysis of the lower extremities or of the rectum or bladder, and a thinning, or entire absence, of the skin over the tumour. (6) The tumour should be examined with transmitted light, and if an opaque band or cords are seen in it corresponding to the spinal cord or nerves it indicates the intraspinal nature of the tumour. (7) The *contents of the tumour* may be examined, and if found to correspond with the cerebro-spinal fluid this sign will prove the swelling to be intraspinal. By these signs the first step in the diagnosis can be taken. Extraspinal tumours must be examined to determine whether they are solid, fluid, or composite, and with what part of the spine or pelvis they are connected. In the case of tumours of the sacrum or coccyx the motions should be examined to see whether any of the contents of the tumour pass into the bowel, and if so a close relation of the tumour to the bowel may be predicated. The surgeon will, of course, examine the interior of the pelvis by the finger in the rectum.

Congenital tumours.—(*a*) If a congenital tumour situated over and fixed to the middle line of the spine be found to fluctuate, to become tenser when the patient cries or strains, and to be reducible within the spine by gentle pressure with increase of the tension of the fontanelle, or of a second similar tumour if it exist, or with the production of nervous symptoms, it is a *spina bifida.* This diagnosis will be corroborated by detecting the edge of the defect in the laminæ of the vertebræ, and by finding any of the frequent complications of this affection (hydrocephalus, talipes, or paralysis), by an examination of the fluid in the sac (*see* page 83), by detection of the spinal cord or membranes in the sac, or by deficiency of the skin over the sac.

(*b*) If a congenital tumour fixed to the spine be found to fluctuate in every part, and if the coverings be thin or translucent, but the tumour incompressible and unaffected by the cries or straining of the patient, and unaccompanied by hydrocephalus, talipes, or paralysis, it is a *false spina bifida*, or a hernial protrusion of the spinal membranes, which has become shut off from the theca vertebralis.

(*c*) If a congenital tumour be found growing from the sacrum or coccyx, sessile, in parts fluid, in parts solid, and varying much in consistence in different situations, extending into the pelvis, and perhaps receiving an impulse from the rectum, or communicating with that viscus and discharging into it fluid material, it is to be recognised as a *congenital sacral tumour.*

(*d*) Where a congenital tumour of this region is felt to contain firm masses of cartilage and bone, and has ill-developed or perfect fingers or toes appended to it, it is a *fœtal tumour*.

(*e*) A solid congenital tumour of the spine with lobulated outline and of soft consistence is a *congenital lipoma*. Such a tumour may extend into the spinal canal, and will then be very firmly fixed to the spine and may be complicated with paralysis of the lower extremities.

(*f*) If a congenital tumour over the spine be found to be reducible by compression, and to fill out with coughing or straining, but does not fluctuate, and is not translucent, it is a *nævus*. If the skin over it be nævoid or thinned, and allow the blue colour of the blood in the tumour to be seen through, the diagnosis becomes easier.

Acquired tumours of the spine offer no special features, and are to be recognised by common characters. In this region, *sebaceous cysts*, *lipoma*, *fibroma*, and *sarcoma*, are met with, and a *bursa* may develop over the vertebra prominens, and if irritated may inflame and suppurate ; it presents the signs of bursal cysts in other situations. In all these cases the surgeon must endeavour to trace the spinous processes beneath the tumour, and so convince himself of the integrity of the spinal column. Very large *abscesses* in connection with caries of the spine may be met with in either the neck, back, or loins.

CHAPTER XXVII.

DIAGNOSIS OF DISEASES OF THE LIPS AND FACE.

THE surgical affections of this region are very numerous, and they may be considered in the following order.

A. **Ulcers of the lips and face.**—Notice particularly the age of the patient, the duration and mode of onset of the disease, the character of the ulcer, whether single or multiple, whether the edge is undermined, punched out, or thickened, whether the base is indurated, smooth, sloughy, or irregular and fungous, and the condition of the connected lymphatic glands.

(1) If the ulcer be single, of short duration, with sharply defined induration of the edge and base, the surface being abraded, ulcerated, or covered with a very thin whitish slough, and several of the glands are enlarged and indurated, being freely movable under the skin, it is a *hard chancre.* This affection is most common on the lips, and in young women. The occurrence of a papulo-squamous eruption on the trunk and fauces, and the other signs of secondary syphilis will confirm this diagnosis.

(2) If the ulcer commenced in early life, and has been very chronic and slow in its progress, having been preceded by soft raised "apple-jelly-like" nodules, some of which are also found scattered around it, it is *lupus.* There may be other signs of struma. The lymphatic glands of the neck may be quite free from disease, and if enlarged this is not secondary to the lupoid ulceration, and is not limited to the immediately associated glands. The discharge often forms adherent crusts.

(3) If the ulcer commenced in adult life, is subacute or rapid in its course, having a punched-out appearance, with sharply-cut edge and sloughy base, without any affection of the lymphatic glands, and originating in firm, red, angry-looking nodules, which quickly break down, it is *tertiary syphilis.* Other evidences of syphilis should be sought for to confirm the diagnosis, which will also be supported by the results of treatment. Syphilis is much more and more rapidly destructive than lupus.

(4) If the ulcer have commenced in middle or late life in a small crack or wart which has steadily spread until an ulcer has formed, and if the base and edge of the ulcer are thickened and indurated, the former being irregular or granular in appearance, and if the connected lymphatic gland is enlarged, it is *epithelioma.* This ulcer is rarely other than single, though the author recently treated a case of double primary epithelioma of the lower lip. It progresses steadily, and usually rapidly.

(5) If an ulcer occurring in a person past middle life, slowly and steadily progresses, destroying all tissues alike in its progress, and making a great chasm in the face, with an edge which exhibits a narrow line of induration, and a smooth, clean, or slightly granular base, the lymphatic glands not being enlarged, it is *rodent ulcer.* Such an ulcer may exist for many years; it may even heal up and then break out again. It usually commences at the junction of skin and mucous membrane or in a wart or pimple.

B. **Acute inflammation and gangrene.**—There are three varieties of acute gangrene of the face that must be distinguished from one another, viz. *cancrum oris, charbon,* and *carbuncle.* (*See* page 351.) *Facial carbuncle* is a very serious form of the disease; the swelling is attended with more bogginess and œdema than in other situations; the slough is to be clearly recognised as subcutaneous in distinction to the cutaneous slough of charbon. The facial vein may be felt thrombosed and inflamed, and abscesses may form in its course if the patient survive the blood-poisoning which usually attends this condition.

C. **Sinus.**—If a sinus in the cheek discharge a thin watery fluid, which streams out during mastication, it is a *salivary fistula.* The nature of the fluid should be tested by its action on starch (page 112). The patient will notice a dryness of the mouth on the same side. If the sinus be puckered in and adherent to the bone, it should be carefully explored with a probe, when necrosed bone or a carious tooth will probably be struck. In all such cases the teeth should be carefully examined. (*See* page 388.)

D. **Fluctuating tumours.**—If a tumour immediately follow an injury, and be attended with bruising of the skin, it is a *hæmatoma.* These tumours sometimes give a curious creaking sensation to the fingers. If preceded and attended by the signs of acute inflammation it is an *abscess.* If chronic, painless, globular in outline, adherent to the skin, and freely movable over the deeper structures, it is a *sebaceous cyst.* These are most common in the region of the whiskers. If like the last, but not adherent to the skin, and especially if it occur in a young person, it may be diagnosed as a *dermoid cyst.* If in the cheek, and becoming more tense during mastication, and associated with dryness of the mouth on the same side, it is a *salivary or parotid cyst.* If situated under the mucous membrane of the lip, being freely movable, and of a bluish colour, it is a *mucous labial cyst.*

E. **Swellings in the parotid region.**—This region is bounded above by the zygomatic arch, below by the angle of the jaw, behind by the edge of the sterno-mastoid muscle, and in front it reaches forward over the masseter muscle.

(1) A solid swelling, quite superficial, freely movable over the deeper parts, and ovoid in shape, is an *enlarged lymphatic gland.*

(2) A general acute swelling of this region, with tenderness and pain, increased by mastication, and fever, is *acute parotitis.* If occurring primarily, affecting both glands, and spreading to the submaxillary and sublingual glands (in some cases), and accompanied with a mild febrile course, it is *mumps.* This generally occurs in children or young persons, and may attack several members of a family. The testicle, ovary, or mamma may be affected by metastasis. Parotitis is also met with as a sequela of acute specific fevers, or in septicæmia and pyæmia. If the surface become œdematous, and the pain and tension increase, and especially if rigors occur or fluctuation can be detected, the surgeon will diagnose a *parotid abscess.*

(3) A tumour situated below and in front of (sometimes behind) the lobule of the ear, projecting outwards, but passing deeply in between the ramus of the jaw and the mastoid process, and being more or less fixed on its deep aspect, is a *parotid tumour.* These tumours vary in shape, but are usually coarsely lobulated. They may be moderately soft, firm, or very firm, and they may vary in consistence in different parts. These differences are associated with varieties of structure, myxomatous tissue being soft, fibrous and sarcomatous tissue being firm, and cartilage being very firm or hard; all these structures, and sometimes also adenoid tissue, are found in varying proportions in these tumours.

F. **Other affections of the lips.**—A chronic thickening of the lip, leading to eversion of its red border, and associated with slow superficial ulceration of its mucous surface, is *strumous hypertrophy.* Small firm shot-like nodules felt under the mucous membrane of the lip are *adenomata* of the mucous glands of the lip. Larger tumours in this situation, if fluid, are *mucous cysts*, and if solid are mixed tumours, often containing myxomatous tissue and cartilage as well as glandular tissue and small cysts; they are known as *labial tumours.* Groups of small clear vesicles on a bright red base, drying up into a thin yellow or brown scab, and attended with itching and smarting, are *herpes.* These may be found in association with an acute inflammatory affection, such as pneumonia, or accompanying slight gastric disturbance. Chronic fissures at the angle of the mouth, with a watery discharge, are *syphilitic rhagades*, they are often seen in children the subjects of inherited syphilis, and they leave behind puckered scars. Flat slightly raised patches of mucous membrane of a pale bluish white colour are *mucous patches.* Irregular fissure-like ulcerations of the mucous surface, chronic in character, and painful, are *syphilitic ulcers.* Corroboration of the diagnosis in these last three cases should, of course, be sought in other syphilitic manifestations. Small whitish spots on the mucous surface, which terminate in very superficial circular abrasions or ulcers, are *aphthæ.* Adjacent ulcers may coalesce; *aphthæ* are attended with pain, soreness, and increased flow of saliva. *Thrush* may be found on the lip, in the form of opaque white streaks and patches, not causing ulceration. If the white material be removed, and examined microscopically, it is found to contain the fibres and pores of a fungus, oidium albicans.

G. If a patient have an acute, painful, and very tender œdematous swelling over either jaw it is probably an *alveolar abscess.* The surgeon should note whether the swelling is fixed to the jaw, and then gently tapping or pressing upon the teeth in succession should determine whether there is tenderness in any one of them, and passing his finger into the mouth should feel for a swelling over the gum. If the swelling be thus fixed to the jaw, and the gum be swelled opposite the reflection of the cheek, and an adjacent tooth be found carious or very tender to percussion, the diagnosis is established. There is often a history of toothache which subsided when the swelling arose. In some cases pus may be found welling up by the side of the tooth.

CHAPTER XXVIII.

DIAGNOSIS OF DISEASES OF THE NOSE.

THE four chief signs of disease of the nose are: *epistaxis*, *discharge* from the nose, *obstruction* of the nose, and *deformity*; and it will be well to consider these individually before proceeding to the diagnosis of separate diseases.

1. **Epistaxis,** or bleeding from the nose, may be *traumatic*, and occasioned by direct injury of the nose itself, or by fracture of the base of the skull (*see* page 83), or *idiopathic*. When idiopathic it may result from local congestion, from disease of the vessels, from altered blood states, or from the rupture of vessels in very vascular growths in the nose. This last cause is at once to be recognised by the obstruction which accompanies the bleeding. Idiopathic epistaxis occurring in young persons otherwise in good health, and especially when preceded by flushing of the face, noises in the ears, giddiness, and headache, is to be attributed to *congestion*; when occurring in the course of fevers or in patients with disease of the liver, it is to be attributed to *alteration in the condition of the blood*. In elderly patients, when preceded by signs of cerebral congestion, and the blood is dark and venous in character, it is due to *congestion*, but when the blood

bright red in colour, flows out very fast, and especially if the superficial arteries are tortuous and rigid, it may be attributed to *rupture of an atheromatous artery.* Epistaxis also occurs from *hæmophilia.*

2. **Discharge from the nose** varies much in its characters; it may be very thin and watery, mucous, mucopurulent, purulent, sanious, mixed with foul-smelling crusts, odourless, or horribly offensive. Mucous and mucopurulent discharge is caused by acute and chronic catarrh, and by mucous polypi; purulent discharge may be due to empyema of the antrum, to alveolar abscess bursting into the nose, to ulceration of the mucous membrane of the nose in ozæna, or to suppuration of the frontal sinuses; an abscess of the brain may discharge through the nose; a very thin watery discharge is caused by polypi in the antrum, and also by escape of cerebro-spinal fluid; sanious pus indicates ulceration; great fœtor of discharge indicates retention of the matter in the nose and its decomposition, and it is usually associated with ulceration of the mucous membrane or necrosis.

Something may be learnt from the mode of escape of the discharge; where this is constant it is probably from the nasal cavity itself; where more or less intermittent it points to the fluid accumulating in some neighbouring cavity, and from time to time escaping into the nose; if it is ascertained that the flow of fluid is greatest when the head is resting on the opposite side it strongly indicates that it is secreted in the antrum; when position has no influence upon the flow it may come from the frontal sinuses, and the bone should be examined for signs of distension of this cavity; headache also should be enquired for. Increased discharge in damp weather is often observed in mucous polypi.

3. **Obstruction of the nose** is indicated by a "nasal" tone of voice, the patient's inability to blow

or sniff up through the affected nostril when the other is compressed, and sometimes also by epiphora. It may be due to displacement of the walls of the nose from fractures and other injuries, to outgrowths from the walls or neighbouring cavities into the nasal fossæ (swelling of mucous membrane, polypi, hæmatoma, abscess, and sarcoma of upper jaw, etc.); and to foreign bodies blocking up the passage; these may be introduced from without, or slowly formed *in situ* (nasal calculi). Similar obstruction to respiration is also due to adenoid vegetations in the choanæ. With mucous polypi the obstruction is greater in damp than in dry weather.

4. **Deformity of the nose** may be *congenital* (when it usually consists in lateral deviation of the septum nasi), or *acquired;* when the latter it is either *traumatic*, the direct result of the violence, or *idiopathic*, occasioned by destruction of more or less of the bony framework of the nose and collapse of that feature, or by distension of its cavity by the progressive growth of a tumour within it. The distinctions between these forms is therefore quite obvious. When the nose is greatly widened transversely, and the eyes pushed outwards and separated from each other, the deformity, which may reach a hideous and exaggerated degree, is known as "frog-face."

Examination of the nose.—The nose should first of all be examined externally to detect any alteration in its contour. Compressing one nostril with his finger the surgeon should request the patient to sniff strongly through the other, when the fact of any obstruction will be at once made apparent; the second nasal fossa must then be similarly investigated. Then placing the patient facing a good light the surgeon should gently press up the tip of the nose, when he will be able to see the anterior nares and the septum, and detect deviation of the septum, ulceration of the anterior nares, or a presenting polypus. To examine the cavity of the nose a speculum should be introduced, and a strong light thrown in by means of a mirror; if any growth or obstruction be seen, a probe should be passed up to it to ascertain its consistence, and an attempt should be made to move it. The posterior nares may be examined by the finger thrust up behind the soft palate, or by "posterior rhinoscopy," a small mirror being introduced into the pharynx behind the velum, and illumined as in laryngoscopy; if the patient be under the influence of an anæsthetic the surgeon may be able to pass his little finger into the nose from the front.

The diseases of the nose will, by means of this examination, readily be divided into those in which there is obvious obstruction to respiration, and those in which there is discharge only, the nasal fossæ being free. The cases in which the discharge has a very offensive penetrating odour are known as cases of ozæna.

A. **There is an inodorous discharge from the nose without obstruction.**—If the discharge be mucous or mucopurulent, it is known as *chronic coryza.* Where this occurs in infants, and leads to difficulty in sucking, and snuffling respiration, "the snuffles," it is a characteristic feature of *inherited syphilis.* When met with in older children, or young adults, and the mucous membrane is found swelled and congested, it is probably due to *struma*, and other evidences of this diathesis should be sought. If fissures and small ulcers are seen in the mucous membrane, it is probably *syphilitic*, and the patient should be carefully examined for evidences of secondary syphilis; *mucous patches* may be found in the nose. In middle-aged and elderly persons the lining of the nostril may be found red and irritable, with dry adherent scabs, or thin watery discharge (*eczema*); such patients are often gouty.

If the discharge be purulent and continuous, examine the floor of the nose carefully for a sinus, and look at the upper incisor teeth; if such a sinus be found, and one of the teeth be carious and tender, it is a sinus left by an *alveolar abscess*. If the discharge of pus be more abundant, and occur periodically, especially when the patient lies down on the opposite side, or blows his nose violently, it is probably an *empyema of the antrum*. If any of the upper teeth are carious this will confirm the diagnosis. In these cases the nasal cavity is healthy, and there is usually no distension of the antrum; the patient may be conscious of an unpleasant smell, and of a nauseous taste in the morning from the pus trickling into his pharynx. If there be a periodical discharge of pus, preceded by headache and sleeplessness, and unaffected by position, it is probably due to *suppuration in the frontal sinus;* any bulging of the walls of the sinus forwards, or into the orbits, will establish this diagnosis.

If there be a constant or intermittent trickling of thin watery fluid from one nostril, and the nasal cavity is quite free, a *polypus in the antrum* must be suspected; if the fluid run out more quickly when the head rests on the opposite side, the diagnosis is strongly confirmed.

B. **There is ozæna.**—Enquiry should be made as to a history of injury, syphilis, and struma, as either of these conditions may induce ozæna. In some cases the history does not reveal any of these causes, and then the affection is known as idiopathic, or spontaneous ozæna, or better, "atrophic catarrh"; by some this would be called "true ozæna." In all cases a probe should be carefully passed to detect bare bone, as necrosis is a very frequent cause and complication of ozæna. Syphilitic ozæna is far more rapidly destructive than is the strumous form, often leading quickly to perforation of the septum and falling-in of the nose;

while, after months or years of strumous ozæna, only ulceration of the mucous membrane may be detected. It must not be forgotten that the impaction of foreign bodies may lead to a fœtid discharge.

C. **There is obstruction in the nasal fossa.**

(1) If the cavity is seen to be filled up with a yellowish or grey soft body which yields and moves before a probe, or moves with strong respiration, it is a *mucous polypus.* These polypi are often multiple, they grow slowly, never cause marked deformity of the nose or frequent and profuse hæmorrhages; they may cause epiphora, and loss of smell; they occasion more distress in wet than in dry weather.

(2) If on examining the cavity a soft red mucous surface is seen projecting from the outer wall of the nose, which is not moved by the probe or by respiration, it is to be distinguished as *hypertrophy* of the mucous covering of the inferior turbinated bone; it is frequently seen in chronic coryza, and might be mistaken for a polypus.

(3) If the nose is found to be obstructed by a deep red or livid mass, firm to the touch, of steady growth, which has been frequently attended with severe epistaxis, the surgeon may diagnose *fibrous polypus,* which should rather be spoken of as a *sarcoma.* This disease is most often seen in young subjects, and it causes great distension of the nasal fossæ, spreading through the septum, widely separating the eyes, filling the antrum, and projecting into the pharynx and mouth. The surgeon should endeavour by his probe or finger to find the point of attachment of the polyp; it may spring from the base of the skull and grow through into that cavity, causing coma and death.

(4) *Deviation of the septum* to one side may cause unilateral obstruction; it will be at once recognised by inspection, and especially by noticing that there is a

hollow in one fossa corresponding to the projection in the other.

(5) Where the septum is found projecting into one fossa without a corresponding depression on the other side, it is a tumour of the septum. Examine whether it is solid or fluid. If fluid and quickly formed, and attended with much pain and redness, it is an *acute abscess.* If fluid, chronic, comparatively painless, and not attended with œdema, it is a *chronic abscess.* If the swelling is firm and solid, but slightly yielding, it is probably an *enchondroma,* while if of stony unyielding hardness, it is an *osteoma.* (For *Hæmatoma of the septum, see* page 112.) If a firm rounded substance is found in one or other nasal fossa, not attached to either wall, it will be diagnosed as a *foreign body.* There may be a history of its introduction, or its examination after removal may show it to be a pea, small marble, or wad of paper, or some similar substance. If, however, it be found calcareous in nature, it is a *nasal calculus ;* these calculi may develop round foreign bodies, which are then found in their interior.

Warts are sometimes seen growing from the mucous membrane; their fine branching surface at once distinguishes them from other tumours.

When the tone of voice indicates nasal obstruction, which is found not to be complete, and the nasal fossæ are free, a careful examination of the posterior nares and choanæ should be made, and if a mass of soft nodules be found there it will be recognised as *adenoid vegetations,* or hypertrophy of the adenoid tissue of the part. This is usually met with in delicate young persons, often in conjunction with hypertrophy of the tonsils; it causes a characteristic flattening of the nostrils, breathing through the open mouth, deafness, noises in the ears, slight discharge of blood into the pharynx in the morning, and excess of mucus in the pharynx, and sometimes chronic coryza.

CHAPTER XXIX.

DIAGNOSIS OF DISEASES OF THE MOUTH, TONSILS, FAUCES, AND GULLET.

The mouth.—The inside of the cheek may be the seat of *mucous patches*, of white patches of thickened epithelium (*ichthyosis*), exactly like and generally accompanying the same affection of the tongue; of *syphilitic ulceration*, and of *epithelioma*. The syphilitic ulcers are irregular, sinuous, often serpiginous, with raised sharply-cut edges, and leave firm depressed cicatrices.

In the floor of the mouth *syphilitic* and *epitheliomatous* ulcers are sometimes found. On passing the finger along the groove between the tongue and the jaw a hard, slightly tender swelling may be found; this is a *salivary calculus*. The patient will usually complain of pain and stiffness about the part, and the submaxillary gland may be found enlarged.

A fluctuating tumour under the front part of the tongue, pushing up that organ and interfering with its movements, covered with thin healthy mucous membrane, and having a translucent bluish appearance, is a *mucous cyst* or *ranula*.

If a fluctuating tumour in the floor of the mouth involve the tongue to a greater or less degree, be deeper in position than a ranula, and project and give fluctuation in the submaxillary region, it is a *sebaceous* or *dermoid cyst*.

A soft lobulated movable tumour in this situation is a *lipoma*.

The palate.—A narrow, highly arched palate is one of the effects of *inherited syphilis*. *Cleft palate* may be limited to a cleft of the uvula, or of the whole soft palate; or the fissure may reach forwards along the hard palate up to the alveolar process, or it may extend through it on one or on both sides of the intermaxillary bone. Rarely, small clefts are seen in the posterior part of the hard palate only.

If the soft palate be of a bright red colour, and the patient experience little or no pain in it, examine the patient for other signs of *secondary syphilis.* If in the reddened mucous membrane small raised papules be seen, or superficial ulcers of the tonsil, the diagnosis is more certain. Oval or circular raised patches, with a pale blue, moist surface are *mucous patches.* If an ulcer of the tonsil have red swelled or undermined edges, and a shreddy base, suspect tubercle, and if there are similar ulcers on the tongue, or the patient be phthisical, or the discharge contain the tubercle bacillus, it is certainly a *tubercular ulcer.* (*See* page 426.)

Perforating ulcers extending quite through the soft or hard palate are *syphilitic.* They may be met with in various stages, with swelled reddened or sloughy edges, or granulating; or the surgeon may find the smooth cicatrised perforations which they leave behind. Firm circumscribed swellings of the palate, showing a tendency to soften, are *gummata.*

If an ulcer be found behind the last molar tooth and spreading up on to the palate, healing by one edge and leaving a hard depressed scar, it is to be recognised as a *serpiginous syphilitic ulcer.*

Extensive ulcers are sometimes seen involving the soft palate, and spreading to the tonsils and pharynx, covered with a foul grey slough, and leading to great destruction of tissue, and subsequent contraction; these are to be diagnosed as *syphilitic.* They will be distinguished from diphtheria or scarlatina maligna by the absence of the acute history and the other special features of those diseases.

When, on examining a throat, smooth rounded perforations in the hard or soft palate, or wide destructions of the arch of the palate, or extensive cicatrices are found, they are to be taken as evidence of past *syphilitic ulceration.* The cicatrisation may shut off the nose from the mouth, or greatly narrow the orifice leading to the larynx or œsophagus.

Hard chancre and *epithelioma* are occasionally met with in the palate. If a patient be taken acutely ill with dysphagia and dyspnœa, and the throat show some swelling from the outside, while the soft palate is greatly swollen and œdematous, so as to conceal the back of the pharynx, the condition is *acute œdematous pharyngitis.*

The tonsils.—A. **Enlargements.**—If the swelling be acute the surgeon must inquire whether it is increasing or diminishing, and he should notice whether any part of it is "pointing," soft to the touch, or even fluctuating, and whether there is surrounding œdema. Where the swelling is chronic, its duration, its mode and rate of growth, its consistence, the limitation of the enlargement to the tonsil or its extension to the palate and pharynx, and the state of the cervical lymphatic glands are the points to be observed.

(1) Where the tonsil is acutely swelled, deep red in colour, with œdema of the anterior pillar of the fauces, and the patient is febrile, with great pain in swallowing and discomfort from sticky mucus about the fauces, it is *acute tonsillitis.* If the swelling be increasing, with severe throbbing pain, and part of the tonsil is found pointing or fluctuating, there is an *abscess in the tonsil.* Where small yellowish-white pea-like swellings, or ulcers formed by the bursting of these abscesses, are found on the surface, it is *follicular tonsillitis.* These follicular ulcers may coalesce into large ulcers with undermined and swelled edges.

(2) Where the tonsil is chronically enlarged the

surgeon has to distinguish between hypertrophy and malignant tumour. If the enlargement affect both tonsils, or, affecting only one, is limited to the tonsil, which is of a healthy pink colour, often much pitted on the surface, enlarging slowly, or quite stationary, and not causing pain unless it becomes acutely inflamed, it is *hypertrophy*.

(3) Where one tonsil is enlarged, the swelling being steadily progressive, and attaining a large size, involving the pillars of the fauces as well as the tonsil, and is covered with livid mucous membrane which may ulcerate on the surface, and there is enlargement of the lymphatic glands at the angle of the jaw and down the neck, the disease is *malignant tumour*. These growths are usually softer than hypertrophy. Both sarcoma and carcinoma affect the lymphatic glands, and to distinguish between them may be impossible. In young persons the disease will certainly be *sarcoma*, but in persons past middle life it may be *carcinoma*; this is much the rarer of the two diseases. The tumours when large may ulcerate, fungate, and bleed freely.

B. **Ulcers.**—(1) Small circular yellowish-grey ulcers of acute origin, formed by the bursting of tiny abscesses, are *follicular ulcers*.

(2) A superficial ulcer, attended with slight redness of the fauces and no induration, is probably a *secondary syphilitic ulcer*.

(3) If the ulcer be deep and excavated, with abrupt sharply-cut edges, and a dirty-grey base, without well-marked surrounding induration or glandular enlargement, it is a *gummatous ulcer*.

(4) If the ulcer be single and have an indurated base and thick everted edge, with extensive surrounding induration, and spread from the tonsil to the tongue or palate, and the glands at the angle of the jaw be enlarged, it is an *epithelioma*. This disease will be met with only in persons after middle life.

(5) If the ulcer be single, indolent with well-marked firm induration around it, and several glands under the jaw and down the neck be enlarged, hard, but quite movable, it is a *hard chancre.* The occurrence of secondary manifestations will, of course, corroborate the diagnosis. The tonsil is a not infrequent seat of *mucous patches*, which have their usual characters.

The pharynx and œsophagus.—The pharynx may be the seat of *syphilitic ulceration*, *sloughing*, and *cicatrisation*, and of *epithelioma.* Pendulous *fibrous tumours* of the pharynx are very rare, and are diagnosed when they are brought into the mouth. The affections requiring further notice are abscess, caries of the spine, and stricture.

1. When a patient complains of dysphagia and dyspnœa the surgeon should examine the pharynx carefully with his finger, and if he find a boggy or soft fluctuating swelling he will recognise it as a *retropharyngeal abscess.* If there be evidence of disease of the cervical spine (*see* page 439), any indication of dyspnœa or dysphagia should suggest this lesion.

2. When an irregular dirty ulcer is seen at the back of the pharynx, the surgeon should probe it carefully. If he feel bare dry bone he should diagnose *spinal necrosis.* This is nearly always syphilitic.

3. If a new-born infant be found to suck well, but unable to swallow, the milk flowing out of his mouth, and at the same time rapid emaciation occur, a *congenital stricture of the œsophagus* is to be suspected. The surgeon should gently pass a small soft well-oiled catheter down the pharynx, and if he meet with obstruction, this will establish the diagnosis, and also localise the stricture. If the milk be regurgitated in quantity, it indicates that the pharynx is dilated into a pouch above the stricture. Regurgitation of milk from the stomach is distinguished by the curdling of the milk and the acid reaction of the returned fluid.

4. When an adult complains of difficulty or inability to swallow, the surgeon must first of all determine whether there is any real obstruction or not, and should see for himself how the act is performed, and notice whether fluid and well-chewed bread can be slowly swallowed. He should inquire as to the apparent seat of obstruction, and the duration and course of the symptoms. He should then look at the general state of the patient's nutrition, and examine the neck and chest carefully for evidences of tumour of any kind. Should there be no evidence of tumour or aneurism, he should proceed to examine the part with a bougie. The patient being seated, and with the head at right-angles to the spine, a well-softened lubricated bougie should be gently passed to the back of the pharynx and on down the gullet; on encountering resistance no pressure should be made, but the bougie may be withdrawn a little, and its direction slightly altered. Smaller bougies may be passed until one is found to pass through and enter the stomach.

(*a*) If the patient be a young or middle-aged woman, of "neurotic," or obviously "hysterical" temperament, and the dysphagia came on suddenly, without any obvious cause, and at once became complete, or is complete for certain articles only, the case may be regarded as *hysterical dysphagia*. This diagnosis will be confirmed by a history of "globus hystericus," and by the fact that the patient can swallow certain articles, or swallows well when unobserved; and it will be rendered certain if a full-sized bougie passes readily into the stomach.

(*b*) If the dysphagia have come on gradually, extend to all substances equally, and the patient have become emaciated and anæmic, while the bougie is arrested in some part of the gullet, there is an *organic stricture*. Should there be a history of an injury or of the swallowing of corrosive fluid, or hot liquid, and especially if the patient be young and no tumour be felt, and the lymphatic glands are unaffected, it may be diagnosed as *traumatic* or *cicatricial stricture.* If the patient be at or past middle life, and a tumour be felt in the neck, or lymphatic glands be found enlarged, or blood-stained mucus be hawked up or come up on the bougie, it is to be diagnosed as *malignant stricture.*

(*c*) Should there be a bronchocele or an aneurism of the aorta, the dysphagia may be attributed to external pressure unless there are very clear indications of stricture. The surgeon must never pass a bougie unless reasonably satisfied that there is no aortic aneurism. Regurgitation of food, unaltered and not acidulated, indicates the formation of a pouch in the gullet above the stricture.

(*d*) Severe pain and difficulty in deglutition coming on immediately after urgent vomiting or the swallowing of a large or too hot bolus, or a sharp fragment of bone, may last for some time, being dependent upon a laceration or abrasion in the œsophagus.

Repeated hæmorrhage from the pharynx, without any obvious cause, is probably due to *œsophageal nævus.*

CHAPTER XXX.

DIAGNOSIS OF DISEASES OF THE TONGUE.

The frænum linguæ may be too short and prevent the tongue being protruded beyond the teeth or moved about in the mouth ; this is the condition known as *tongue-tie.* The tongue may also become adherent in the mouth through the cicatrisation of ulcers. Other congenital malformations of the tongue are fissures in the tongue, absence of the tongue, and imperfect development of the tongue with adhesion to the floor in the mouth.

A. **General enlargement of the tongue** is due either to macroglossia or acute glossitis. If it is a chronic affection, congenital or noticed soon after birth, and the tongue is tough, uneven on the surface, with enlarged papillæ, and small rounded glistening elevations, it is *macroglossia.* The tongue may attain a very large size; the exposed part is then hard and dry, and its surface may be fissured and ulcerated, while the lower jaw is deformed by the pressure of the mass.

If the swelling of the tongue be acute, attended with pain and much distress from dyspnœa, dysphagia, and fever, and the surface of the organ is livid and indented by the pressure of the teeth, it is *acute glossitis.* This may be limited to one half of the tongue; if fluctuation can be detected in the swelled organ it indicates an *abscess.* The disease may arise from mercurialism, iodism, cold, and other less understood causes. A moderate amount of swelling of the tongue is common in ptyalism.

B. **Tumours of the tongue.**

(1) If a tumour be congenital in origin, livid, or bright-red in colour, compressible, not fluctuating, swelling out under effort, it is a *nævus.* The diagnosis of this condition is usually quite obvious.

(2) A branched villous growth from the surface of the tongue without any induration or swelling of the tongue itself is a *wart* or *papilloma.*

(3) A pendulous or pedunculated firm growth, of rounded outline, and covered by smooth healthy mucous membrane, is probably a *fibroma.*

(4) A firm infiltrating tumour growing rapidly in the substance of the tongue, painless, and not causing trouble except from its size, is a *gumma.* These tumours may be superficial and small, or seated in the

muscular substance of the tongue where they attain a larger size. They have a tendency to soften and ulcerate.

(5) Other very rare solid tumours of the tongue are lipoma, enchondroma, sarcoma, and scirrhus.

(6) If a fluctuating tumour be found in the substance of the tongue, and there be evidence of inflammation, or of injury connected with it, or if the surrounding tissues be swelled or tender, it is to be diagnosed as an *abscess.*

(7) If a fluctuating tumour be quite superficial, growing from the mucous membrane, of a bluish opalescent appearance, and painless, it is a *mucous cyst.* If too small to give the sense of fluctuation, the diagnosis must be made from the globular outline, translucent appearance, superficial position, and the absence of all signs of inflammation.

(8) If a very chronic tense globular fluctuating tumour be found in the tongue, deeper than a mucous cyst, and unattended with signs of inflammation, it may be diagnosed as a *hydatid cyst.* If inflamed and suppurating, it is indistinguishable from an abscess unless there is a clear history of a long pre-existing tumour.

(9) A softening *gumma* may give rise to a fluctuation: it will be recognised by the induration around the fluid, and by the history of a hard lump in the tongue which has become soft, and also by the other signs of syphilis, and by the effects of treatment.

In any case of fluctuating tumour where the surgeon is doubtful of the diagnosis he should make an exploratory puncture and examine the fluid that escapes. (*See* pages 274 *et seq.*)

C. **Ulcers of the tongue.**

(1) *Age.*—Children are subject to aphthous ulceration; at and after middle age epithelioma becomes common.

(2) *Duration.*—Aphthæ are of short duration; syphilitic ulcers are chronic and are very prone to relapse; epithelioma is steadily progressive.

(3) *Depth and position.*—The deep ulcers are epithelioma or ulcerating gumma; although both these diseases may exist as superficial ulcers. Gummatous ulcers and dyspeptic ulcers are generally on the dorsum; epithelioma, aphthæ, and syphilitic fissures are commonest at the edge; chancre is generally near the tip; mercurial ulceration is on the under surface.

(4) *Induration* of the base and edges of an ulcer is an extremely important sign; any ulcer when chronic may become indurated; those specially characterised by induration are chancre and epithelioma.

(5) *The teeth* should be carefully examined to see if there is any rough mass of tartar, or sharp corner opposite the ulcer; the presence of a plate of false teeth should also be taken note of.

(6) The *lymphatic glands* under the lower jaw become enlarged in chancre and epithelioma. (*See* page 284.)

(7) *Concomitant affections* should be enquired into; among these may be specially mentioned syphilitic affections of all kinds, dyspepsia, salivation, phthisis, and ulcers on the fauces, cheeks, and lips.

(8) *Microscopical examination* of a scraping from the surface of the ulcer. (*See* page 273.) If the scraping consist of blood and pus-cells and normal epithelium, a little of it should be stained,* and if the tubercle bacillus is found, the sore is a tubercular

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* To stain tubercle bacilli spread some of the scraping thinly on a cover glass, and dry over a bunsen burner; then heat a few drops of Gibbes' rosanilin and methyl blue stain, pour into a watch glass, and invert the cover glass on this, and leave it for five minutes, then wash it in methylated spirit, and dry over a spirit lamp, and mount it in Canada balsam. The tubercle bacilli appear as fine rods stained of a red colour; putrefactive bacteria and micrococci will be seen stained blue.

ulcer; syphilitic and other simple sores show no distinguishing structures.

(9) *Effects of treatment.*—When a doubt is entertained it is often useful to give the patient iodide of potassium, when, if it heal up, the ulcer is shown to be gummatous; improvement of a sore under mercury would show it to be due to the earlier manifestations of syphilis. The healing of an ulcer under anti-dyspeptic treatment, or after the removal of a jagged tooth, indicates that it is a dyspeptic or local ulcer.

(*a*) If the ulcer be quite superficial, painful and tender, looking sharply punched-out, and especially if multiple, situated on the sides and tip, and there are other similar ulcers on the lips or cheeks, it is *aphthous*. Aphthæ commence as small white blisters, run a rapid course, and are accompanied with slight salivation.

(*b*) If the ulcer be situated on the side of the tongue being ragged and irregular, without induration of its edge or base, unless it is very chronic, and then with only limited induration, and it be opposite a mass of tartar, or an angle of a tooth, or the edge of a "plate," it is a *local ulcer*. This diagnosis will be confirmed if on removing any local irritation the ulcer heal up. The glands are not enlarged.

(*c*) If the tongue be swelled and there be salivation with great fœtor of the breath, and along the under surface of the tongue and at the tip there are irregular superficial ulcers with greyish base, while the gums are swelled and softened or ulcerated and receding from the teeth, it is a case of *mercurial ulceration*. The knowledge that the patient is exposed to the influence of mercury in some form will establish this diagnosis.

(*d*) A superficial crack or fissure on the side or tip of the tongue, multiple, chronic, or relapsing, is *syphilitic ulceration.* This form is very common in the secondary period of the disease, and accompanying it are often found mucous patches, similar ulcers of the cheeks, or papular eruptions on the skin.

(*e*) A chronic superficial circular or oval ulcer on the dorsum of the tongue with a smooth base, free from induration and without glandular enlargement, is probably a *dyspeptic ulcer*, and the surgeon must look for signs of lithæmia or gouty dyspepsia.

(*f*) A single ulcer of recent origin near the tip of the tongue, with marked induration of the edge and base, and induration of several glands beneath the jaw, is a *chancre.*

(*g*) Shallow sinuous fissures on the dorsum of the tongue, the intervening mucous membrane being healthy, are to be regarded as *syphilitic.*

(*h*) If an ulcer on the tongue have a thin undermined edge, and a depressed shreddy base, without surrounding induration, it must be suspected to be a *tubercular ulcer.* If the patient show signs of phthisis, or if a scraping from the sore contain tubercle bacilli, this diagnosis becomes certain. These ulcers may be single or multiple, and may be found on the palate and fauces as well as on the tongue.

(*i*) If an ulcer on the dorsum of the tongue be deeply excavated, with a greyish, dirty, sloughy base, and if the history show that there was at first a hard lump in the tongue which softened and burst, it is to be diagnosed as an *ulcerated gumma.*

(*j*) If an ulcer on the tongue of a middle-aged or elderly person have a widely indurated base, thick everted edge, and an irregular warty surface with a watery discharge, and there be enlargement of one or more of the submental glands, it is an *epitheliomatous ulcer.* These ulcers are more common in men than women, and are generally seated on the side of the tongue. As they spread (and their growth is continuous) they interfere with the movements of the tongue, or may bind it down to the mouth or jaws. The disease usually begins in a crack, or a wart-like papule, or a blister, or in leucoplakia.

D. **Non-ulcerative affections of the mucous membrane.**

(1) A milk-white deposit on the tongue which can be scraped off, leaving the surface a little raw, and which under the microscope shows spores and fibres of oidium albicans, is *thrush.*

(2) Slightly raised patches of mucous membrane having a pale-blue opalescent appearance, are *mucous patches.* Look for other evidences of syphilis.

(3) A pale pink rash in rings or crescentic patches, spreading rapidly over the surface of the tongue, leaving the mucous membrane smooth and deep red in colour, without pain, ulceration, or salivation, and quite uninfluenced by treatment, is *annulus migrans.*

(4) If the surface of the tongue be red, smooth, with a glazed appearance, as if bare of its epithelium, it is *subacute superficial glossitis.* This is often spoken of as the "smooth glazed tongue."

(5) If the surface of the tongue is slightly thickened, of a white colour, with irregular cracks across the thickened epithelium, the condition is that known as *leucoplakia, ichthyosis linguæ,* or *chronic superficial glossitis.* This condition often lasts many years; it varies somewhat in appearance, but is characterised by the white colour of the surface and the thickening and hardening of the epithelium.

(6) When a patch of leucoplakia becomes affected with ulceration, or deep fissures, and the edge and base of these fissures are felt to be indurated, and especially if at the same time the submental glands become enlarged, the disease is now *epitheliomatous.*

(7) If the surface of the tongue be puckered, or depressed along interlacing lines, and along these lines

or puckerings firm bands are felt, the condition is *syphilitic sclerosis.* The sclerosis is deep, and may leave the mucous membrane quite healthy.

CHAPTER XXXI.

DIAGNOSIS OF DISEASES OF THE NECK.

THE lymphatic glands of this region consist of a series lying under the body of the jaw, of another series between the chin and the hyoid bone, of a third set along the external jugular vein, and of a fourth series, deeper than these, lying along the carotid sheath, beneath the sterno-mastoid muscle, and extending beyond that muscle into the posterior triangle of the neck. These glands are very frequently enlarged, either from inflammation, acute or chronic, cancerous deposit, or lymphadenoma. Inflammation of the glands is very often to be traced to some local irritation in the area supplying lymph to the affected glands, in other cases it is due to syphilis or struma.

A. **Acute swellings of the neck** are, with the rare exception of that produced by emphysema (page 116), inflammatory in their nature. The surgeon must endeavour to discover the seat of the inflammation, and whether suppuration or sloughing have occurred.

(1) If the swelling be in the position and have the outline of a lymphatic gland, be firm and unyielding to the touch, and without much surrounding œdema, it is an *inflamed lymphatic gland ;* if fluctuation be obtained in such a swelling, it is a *glandular abscess.*

(2) If the swelling occupy one side of the neck,

and the head be turned to the opposite side, and attempts to rotate it cause pain, while the inflamed part is very painful, ill-defined, and tense, it is to be diagnosed as *cellulitis* beneath the *sterno-mastoid muscle*, and if the superficial parts are œdematous and glossy, and *à fortiori* if there be deep fluctuation, *abscess* beneath the muscle is to be diagnosed. This inflammation is probably lymphatic in origin. It is important to detect suppuration at once, and, therefore, increasing swelling, tension and fever with marked superficial œdema warrant a puncture or small incision, even in the absence of fluctuation. A similar swelling in any other part of the neck will be recognised by the same characters to be deep *cellulitis.*

(3) If the swelling take the form of a hard collar-like induration, extending between the jaw and the hyoid bone, pushing forwards the skin of this region, and raising and fixing the tongue, it is to be diagnosed as *angina ludovici;* this swelling may come on very rapidly, and quickly lead to œdema glottidis, or sloughing of the cellular tissue, and fatal blood-poisoning. When first seen there may be a sinus in the floor of the mouth leading into the sphacelated tissue. It is only when this form of cellulitis is idiopathic that it claims the above name. It may be traumatic from injuries or operations in the mouth, or may have spread from inflammation of the glands of the part.

(4) If the swelling be very painful and tender, ill-defined, livid red in colour, and indurated, and there be small vesicles on the surface, or several small apertures in the skin exposing a soft grey slough, it is a *carbuncle.* This disease may be met with at any part, but is very common at the back of the neck. Carbuncles vary much in their rate of progress, some being very chronic; they are usually single. Examine the urine for sugar.

(5) If the swelling consist of a hard flat or conical elevation of the skin, deep-red in colour, clearly defined, painful and tender, on the summit of which a small pustule forms, which bursts and discloses a tough greenish slough of the deeper parts of the skin and perhaps also of the subcutaneous tissue, it is a *furuncle.* Furuncles are generally multiple, and although very common on the neck, are often widely distributed over the body. The "flat" or "blind" boil is sometimes distinguished from the more prominent "conical" or "ordinary ' boil.

B. **Chronic swellings** may be conveniently grouped into *fluid*, *solid*, and *pulsating* tumours.

(1) *Fluid tumours* are either *cysts* or *abscesses.* If the tumour be congenital, and consist of a single sac of fluid, as proved by fluctuation extending quite across it in every direction, and no solid matter be felt in it, it is a *hydrocele of the neck*, or *serous cyst.* If of large size, such a tumour may be translucent; if tapped, clear watery fluid escapes. Where a congenital tumour is found to be partly fluid and partly solid, forming a soft lobulated irregular swelling, it is a *cystic hygroma* (page 285). If the tumour be tense, rounded in outline, and situated over the pomum Adami, or over the side of the thyroid cartilage, and if it move with the larynx during deglutition, it is a *bursal cyst;* when tapped a glistening jelly-like fluid escapes. If the tumour be situated on either side of the trachæa or larynx, and it be found to rise and fall with the larynx during deglutition, it is a *thyroid cyst.* These cysts may be single or multiple; when tapped they may afford a clear glairy mucous fluid, or a dark red fluid containing altered blood pigment and cholesterine. If the tumour be globular in outline, tense, fixed to the skin, and freely movable over all the deeper parts, it is a *sebaceous cyst.* The *dermoid*

cysts described on page 417 may form prominent swellings in the neck, and extend down under the sterno-mastoid muscle in connection with the sheath of the carotid vessels. They are distinguished by their depth, their immobility during deglutition, their extending into the floor of the mouth, and, if tapped, by the opaque fatty fluid that escapes. If the tumour correspond in position to a lymphatic gland, or be accompanied by signs of inflammation in the part, or in the spine, or if it be the sequel to a solid tumour which has softened down, it is to be diagnosed as a *chronic abscess.* The great majority of these abscesses are of lymphatic origin, occurring in young delicate subjects who show also enlarged glands or old scars. Where this is not the case, and the abscess is deep, and especially if pointing low down behind the sterno-mastoid muscle, a careful examination of the spine should be made.

(2) *Solid tumours.*—Those most commonly met with are *glandular.* (*See* page 283.)

If the tumour occupy the middle of the sterno-mastoid muscle, and is movable only with that muscle, and when it is relaxed, it is known as a *sterno-mastoid tumour ;* this is met with in young children, as a congenital affection. Soft solid tumours, with ovoid or flattened lobules to be felt at one or more parts of the surface, will be recognised as *lipomata.* When occurring in the superficial fatty tissue they are more globular and prominent than in other parts of the body, and may resemble in shape sebaceous cysts. The author recently had under his care two congenital lipomata of the neck, one of which involved the clavicular head of the sterno-mastoid muscle, and grew also from the periosteum of the clavicle; the other was beneath the complexus muscle just below the occiput, and was closely adherent to the spine. He recently saw also a large globular superficial lipoma which might have been easily mistaken for a sebaceous cyst.

A solid tumour in the front of the neck, below the larynx, or on either side beneath the sterno-mastoid muscle, moving with the larynx in deglutition, is a *bronchocele.*

When of very great size bronchoceles may lose their mobility with deglutition. The enlargement may affect any part or the whole of the gland, and the outline of the tumour varies accordingly. If the bronchocele is uniformly soft and elastic to the touch, it is known as a *simple bronchocele;* but if it is irregular in outline, with dense nodules or bands in it, it is a *fibrous bronchocele;* while if it pulsates, the pulsation being expansile and unaffected by raising the tumour away from the carotid artery, it is a *pulsating bronchocele;* this, when combined with exophthalmos, is known as *exophthalmic goître.* The surgeon should feel carefully for fluctuating areas, which may be single or multiple; and which are diagnostic of *cystic bronchocele.* There is a tumour of the thyroid gland which is associated with growths (probably secondary) occurring in the bones of the skull, pelvis, spine, clavicle, etc.; this form is known as *malignant bronchocele.* The surgeon should specially notice whether there is evidence of pressure upon the trachæa, œsophagus, or recurrent laryngeal nerves.

C. **Pulsating tumours of the neck** form an important class. The surgeon must first of all decide whether the pulsation is inherent in the tumour or only transmitted to it, and if the former whether the tumour is an aneurism or a very vascular growth. The swellings liable to be mistaken for an aneurism are pulsating bronchocele, simple or cystic bronchocele lying over the carotid artery, and abscess over the carotid artery. A study of chapter xviii. will enable the surgeon to distinguish these various swellings with certainty. But it may be here pointed out that bronchoceles move with deglutition; aneurisms do not. A pulsating abscess fluctuates readily, but is quite incompressible when the artery is compressed on the cardiac side of the tumour.

When the surgeon has decided that a given pulsating tumour is an *aneurism*, he must then determine from which artery the tumour springs. When occurring in the upper carotid triangle it will be at once recognised as a *carotid aneurism;* if limited to the posterior triangle it is equally easy to diagnose a *subclavian aneurism*, but when the aneurism is placed at the root of the neck in front it may be difficult or impossible to determine this point. The surgeon should learn, if possible, where the tumour first appeared; if between the two heads of the sterno-mastoid on the right side it is probably *innominate aneurism;* if internal to the sternal head it is probably *carotid aneurism;* if external to the interval it is probably a *subclavian aneurism;* this sign is not absolutely decisive, and in many cases the surgeon cannot obtain it. He must then study the pulse in the arteries beyond the aneurism, comparing it with those in the same vessels of the opposite side. If the pulse in the carotid artery and its branches is unaffected it shows that the aneurism is neither innominate nor carotid; similarly if the subclavian or brachial pulse is unaffected, it shows that the aneurism is neither innominate nor subclavian, and *vice versâ.* The pulse in either of these arteries may be affected by the tumour involving the parent trunk, by its occluding the mouth of the artery, by some portion of the sac compressing the vessel, or lastly, by a portion of clot plugging the vessel. Aneurisms of the arch of the aorta may extend up into the root of the neck.

In aneurisms at the [illegible] surgeon

must carefully notice whether there is dyspnœa or respiratory stridor (either from pressure upon the trachæa or upon the recurrent laryngeal nerve) dysphagia from pressure upon the œsophagus, or irregularity of the pupil on the same side from pressure upon the sympathetic. Pressure upon the recurrent laryngeal nerve will be shown by paralysis of the abductor muscle of the same side and fixity of the vocal cord in the cadaveric position. In pure trachæal stridor and dyspnœa the larynx is immovable and the vocal cords will be seen widely abducted with each inspiration; the two forms of respiratory difficulty may co-exist, and it is very important to remember this when contemplating opening the trachea to relieve laryngeal obstruction.

D. A small congenital fistula or sinus in or near the middle line of the neck is a remnant of a *branchial fissure.* These fistulæ are most common close to the sternum; they may communicate with the trachæa or pharynx; this is shown by the escape of air or liquid.

E. **Rigidity of the neck** is a symptom which accompanies an important group of diseases. The head may be fixed in the upright position, or it may be inclined to one or other side.

(1) If the head be drawn down and rotated so that the chin is turned towards one shoulder and the occiput towards the other, and one ear is approximated to the clavicle, while the neck on that side is hollowed, and on the other convex, the deformity is known as *torticollis* or *wry-neck.* In many cases the deformity is *congenital,* and in these the face on the same side develops less rapidly than on the other side, the eye becomes oblique, and the cervical spine curved. If acquired, search must be made for its cause; in children, painful inflamed glands may be found beneath the sterno-mastoid muscle, or there may be a history of such; these cases may be distinguished as *inflammatory;*

in young women it is met with as a result of *hysteria*; in this form the muscular spasm may vary from time to time, subside altogether at intervals, and even change sides. Where any attempt at movement causes severe pain, and especially where neither of the above causes is present, suspect *caries of the spine.* (*See* page 439.) Another rare form of this affection is due to *paralysis* of one sterno-mastoid muscle, which will be recognised by the great wasting of that muscle and the ease with which the deformity may be at any rate partially corrected by the surgeon. Where the head is from time to time jerked into the position of wry-neck from clonic spasm of the sterno-mastoid muscle, it is distinguished as *clonic spastic torticollis.*

(2) If the head be fixed upright, or but slightly inclined to one side, or with the chin poked forward, the surgeon has to diagnose whether the condition is dependent upon disease of the spine or is "muscular rheumatism." The history of the case must be studied, whether the rigidity and pain came on gradually or suddenly, followed on injury or exposure to cold, and attention should be paid to the character of the pain, its exact seat, whether increased at night, or relieved by friction and warmth. The examination should be conducted with great gentleness and care. The patient being seated, the surgeon should place his hand flat on the top of the head, and gently press it vertically down, graduating the pressure, and watching for any expression of pain. Then grasping the head, with one hand under the chin, and the other below the occiput, he should steadily lift it, and ask whether that relieves the pain or not. Grasping the head again at the sides, he should gently rotate it to either side, and nod it to and fro, and notice whether and when rotation causes any pain. Then a careful examination of the spine should be made with a view of detecting any undue prominence of the cervical spinous processes or thickening

around them, and the pharynx should be examined for a reto-pharyngeal abscess. An abscess or sinus in any other situation of the neck will be noticed.

If the pain and stiffness have come on suddenly, or after exposure to cold, and if they be found to be relieved by heat and by gentle friction, and not to be worse at night, while gently raising or depressing the head on the spine does not give pain, it is probably *rheumatism*. The surgeon should then learn which active movements are most painful to the patient, and if he find that these very movements when passive are not painful, but that the opposites are, and if there be no sign of abscess, or protrusion of any of the cervical spines, this diagnosis will be established. The movements and manipulations must all be made without jar or shake, and in applying the test of the different effects of active and passive movements, the surgeon must be sure that the latter are really passive, and not partly active. If, for instance, a patient complain that he cannot actively extend the head without pain, but the surgeon finds that he can passively place the head in the extended position without pain, it demonstrates that the pain in the former case is not due to the position but to the agent, the muscle. Further, a muscle whose contraction is painful cannot be stretched without giving pain, and therefore when the head is well bent forwards so as to put these extensor muscles on the stretch, pain will be caused. The same phenomena are observed in the cases of "rheumatism" of the rotator muscles of the spine. When several muscles are affected some difficulty in diagnosis may be experienced, but with patience and care on the part of the surgeon, and docility and intelligence on the part of the patient, it is usually possible to come to a correct conclusion. In some cases great aid is afforded by observing the precise seat of pain and of tenderness, and noticing that it is in the particular muscle contracting or stretched in the painful movements.

Where, however, the surgeon finds that the pain and rigidity have come on gradually, that the pain is worse at night, and is exaggerated by all movements; that pressure of the head down upon the spine gives pain, while raising the head relieves the pain or removes it altogether, he must diagnose *caries of the spine.* Should there be protrusion of the spine behind, swelling over the spine, or great local tenderness, or an abscess behind the pharynx or in the posterior triangle of the neck, the diagnosis will be rendered more easy and more certain. The surgeon should first try whether the simple nodding movement of the head is possible and painless; if so, it shows that the *occipito-atloid* joint is free from disease, while if any attempt at this movement causes great pain and great muscular spasm, while the other movements are more free, it indicates that this joint is diseased. If simple limited rotation of the head from side to side is painless, the *atlo-axoid* joint is not diseased, while if this movement, even to a small extent, is resisted, and is very painful, it points to disease of this articulation. When these two joints are found free from disease, but there is deformity or tenderness to vertical pressure and pain on carrying either nodding or rotation of the head beyond the degree possible in the two highest spinal joints, it shows that the disease is in the *lower cervical* vertebræ. Search should be made for evidence of syphilis in cervical caries. Retro-pharyngeal abscess must be regularly watched for in these cases. In disease high up in the cervical, swallowing a large morsel or taking a sudden deep inspiration may cause pain referred to the larynx or shoulder.

CHAPTER XXXII.

DIAGNOSIS OF DISEASES OF THE BREAST

THE importance and often the difficulty of the correct diagnosis of affections of the breast are so generally recognised that it is not needful to insist upon those facts here. It may be well to impress upon the student the necessity of bearing in mind the important physiological changes occurring in this gland. The earliest of these is the slight engorgement with consequent swelling, slight tenderness and induration, that may be observed a few days after birth, perhaps more marked in male than female children. In this state inflammation is readily set up by injudicious management, and abscesses may result. In girls at puberty (sometimes just before, but more often just after the first appearance of the menses) the gland usually undergoes a considerable but very variable degree of enlargement, the nipple develops and the areola becomes broader and better marked. The commencement of this change, particularly if it occur on one side earlier than on the other, may be mistaken for the development of a tumour, but a proper examination will exclude this error, and a consideration of the patient's age will at once suggest the true nature of the case, which will be further cleared up by time. At or soon after this period it is not uncommon to see acute suppuration under the skin of the areola or that covering the mamma proper. In males at this age there is often noticed an abortive development of the gland giving rise to a small, firm, disc-shaped swelling under the nipple, which may be a little tender to pressure. A knowledge of this fact will prevent any error of diagnosis; the swelling is not always bilateral, and if bilateral not always symmetrical.

The full evolution of the gland only occurs during pregnancy and lactation, and is followed by a corresponding involution. The only one of these changes that requires mention here is the formation of small firm rounded nodules caused by the full development of the acini of the gland; the distinctness with which these are to be felt increases towards the end of pregnancy, and varies with the amount of fat around the lobules or under the skin. Simple tumours may originate at this period, but cancer very rarely. Occasionally abscess is met with in a lobe of the gland during pregnancy, as the writer recently saw in a patient under his care. During lactation inflammatory troubles and abscess become very frequent.

At the climacteric, the gland undergoes extensive involution, the acini become smaller, and eventually disappear. It is during this period of involution of the gland that cancerous tumours most frequently develop.

The examination of the breast should be conducted with the patient reclining upon a couch or seated on a chair before a good light, with the shoulders well supported. The surgeon should examine the parts in the following order: *nipple*, *areola*, *skin over the breast*, the *gland* itself, and then the *axillary glands.*

1. **Examine the nipple,** noticing its *size*, whether large, small, or rudimentary; its *shape*, whether prominent, flattened or retracted, and whether it is *bound down* to any part of the gland; its *surface*, whether inflamed, discharging, ulcerated or covered with scabs, or dotted over with firm bright specks; and whether there is any *discharge* from its ducts, milky, mucous, or bloody. If the shape of the nipple be abnormal, it should be enquired whether it is a

malformation or an acquired deformity; *malformations,* especially retraction and inversion, may cause obstruction to the outflow of milk, milk-congestion and mammary abscess; where *retraction* is acquired, it indicates a dragging upon the galactophorous ducts. Where there is discharge, care must be taken to determine whether it flow from the ducts which open on the top of the nipple, or exude from inflamed or ulcerated skin covering the ducts; this is decided by the presence of cracks or fissures, and by the effects of compression of the gland. Where the nipple is red, painful, very tender, and sero-purulent fluid is found exuding from cracks or fissures, the condition is known as *cracked nipple;* this is commonest at the tip and around the base of the part. When the watery discharge dries into thin yellowish scales, the skin beneath being red and itching, but not acutely painful and tender, it is *eczema of the nipple.* Small bright projections on the tip of the nipple are epithelial *plugs* in the *ducts;* these may be found in the form of small hard gritty *calculi.* A secretion from the lacteal ducts indicates some active secreting process in connection with the gland or its ducts, and the nature of the secretion should be noticed.

If in a patient at advanced or middle life there be on the nipple a chronic ulcer with firm thickened irregular edge, and an irregular indurated base discharging ichorous fluid, and if the induration and the ulceration steadily increase in area, while the glands in the axilla are enlarged and indurated, the disease is *epithelioma of the nipple.*

2. **Examine the areola.**—During pregnancy and lactation the large sebaceous glands in the skin may form quite marked projections from the surface; these must not be mistaken for pathological appearances. Any redness or swelling of the part is to be carefully

taken note of, as well as the presence of discharge or scales of any kind and the adhesion of the skin to a subjacent swelling. Sometimes *dilatations of the galactophorous ducts* can be recognised both by sight and touch as smooth soft pyriform swellings under the thin skin of this region. *Abscess, sebaceous cyst, hard chancre, mucous patch*, and *eczema* may be found in this situation.

3. **Examine the skin over the breast.**—Notice any change in its appearance, redness, discharge, scabs, œdema, retraction, fixity to the adjacent structures, and hyperæsthesia. Fixity of the skin to the breast is due either to inflammation or to some other infiltration, and in the absence of inflammation it is an important indication of the mode of growth and hence of the nature of a neoplasm. If the skin be red, discharging a watery fluid which stiffens linen and dries into yellowish scabs, the condition is *eczema*. If this disease have lasted for years in spite of all treatment, and have during that time slowly spread at its edges, but nowhere undergone cure, it is the particular form of disease which is prone to be followed by the development of a cancerous tumour in the subjacent gland; as the exact nature of the change in the skin is still a matter of dispute among pathologists, it is best known as *Paget's disease*, to distinguish it from the commoner and curable disease, *eczema*. Although attended with results so different from simple eczema, it is impossible to diagnose this serious disease except by its clinical course.

If the skin be swelled, bright red in colour, painful, very tender, and the swelled part fluctuate, and if there be no evidence of inflammation in the gland itself, the affection is a *supramammary abscess*. This may occur quite independently of lactation. The freedom of the gland from inflammation will be recognised by the moderate amount of pain and general disturbance, the more rapid advance of the mischief to fluctuation or pointing, the superficial character of the swelling, and the absence of induration of the lobes of the gland.

If without redness of the skin or other signs of inflammation, gentle contact of the hand cause acute pain, there is *hyperæsthesia of the mamma.* If this tenderness involve the whole region, and if it be especially marked over the points of exit of the anterior and middle cutaneous nerves of the 2nd, 3rd, 4th, and 5th intercostal spaces, and if the pain radiate to the back and shoulder, it may be diagnosed as *neuralgia.* But if the pain be elicited by contact with certain spots only of the breast, and, further, if at these spots small, firm, round or ovoid tumours be felt movable under the skin and over the breast in one direction, pressure upon them causing acute pain radiating from them over the mamma, the tumours may be recognised as *neuromata,* and as the source of the hyperæsthesia.

4. **Examine the mammary gland.**—If the patient be suckling, and one lobe of the gland or the whole breast be found swelled, firm, with fine nodulation of the surface from distension of the glandular acini, the skin over it being freely movable, not reddened, with large blue veins coursing under it, and if the part be not acutely painful or tender, it is to be diagnosed as *milk congestion.* If the patient have suddenly stopped suckling, or the secretion be found to be thick, or the nipple be rudimentary, or inverted, or inflamed, or its ducts obstructed, this diagnosis will be confirmed and the condition explained. If unrelieved, the tension quickly excites acute inflammation, running on to suppuration; if there be fever, with or without rigors and sweating, acute throbbing pain, great tenderness and heat of the part, with redness of the skin and œdema which obscures the

exact outline of the swelling, even in the absence of fluctuation, *mammary abscess* may be diagnosed. The axillary glands, one or several, will be found enlarged and tender.

If the breast be prominent, the skin being stretched, and the nipple pointing, and if pressing the gland back against the chest cause pain and give a sensation as of fluid under the mamma, and particularly if there be swelling detected at the axillary border of the gland, which becomes more tense and prominent when the gland is pressed back, the diagnosis of *submammary abscess* should be made. This will be confirmed if there be enlargement of the axillary glands, and pain on bringing the pectoral muscle into action.

If both glands are found of an unusually large size, and steadily increasing in size, not painful nor inconvenient except from their bulk and weight, and of normal consistence and feel, the condition is *hypertrophy.* Remembering that without overstepping the limits of health, the breast attains a great size in some women, this diagnosis must only be made when the glands have attained enormous dimensions and are found to steadily increase for months or years. Two forms are to be recognised, in one of which the gland is very loose, soft, and pendulous, while in the other it is firmer, tenser, and projects forwards. Hypertrophy is generally bilateral, but not always symmetrical, and it is most common in young women, the growth starting at puberty.

If the surgeon can exclude these conditions, which are so obvious that no special directions for their diagnosis are required, he must next determine whether there be tumour or growth in, or in connection with, the gland. For this purpose he should stand behind the patient if she be seated, and press the fingers flat upon the breast towards the ribs, when he will be able with certainty to determine whether there is anything more than the mammary gland over the chest. He must be careful not to grasp the gland between his finger and thumb, as in that way there may be a semblance of tumour where none really exists.

If there be no tumour, but, when grasped between the finger and thumb, the breast gives a greater sense of resistance than normal, and if such induration be felt in a patient not suckling, it is to be diagnosed as *chronic induration of the mamma.* This may be uniform, or affect only a part or parts of one or both glands; it is often associated with neuralgic pain and hyperæsthesia, and is commoner in sterile than in fruitful women, and especially between the ages of 25 and 40.

Tumours of the breast.—The surgeon should determine its relation to the gland by grasping the tumour in one hand, and the gland in the other, and trying if the one move independently of the other; he should then notice whether it is situated towards the centre or the periphery of the breast, and if its outline correspond to the mammary lobes and lobules. Tracing its surface with his finger, the surgeon should notice whether it is smooth, nodular or lobed, and particularly whether its edge is rounded, sharply marked off from the surrounding tissue or more or less ill-defined and gradually fading into them. Its consistence, whether hard, firm or soft and elastic, and whether fluctuation can be detected in it in all parts, or merely in some parts, will be determined, and the surgeon should then notice whether the skin be dimpled over it or adherent to it, whether the nipple is retracted and adherent to it, and the tumour fixed to or freely movable over the pectoral muscle. The fact of ulceration of the skin, and the character of such ulcer, will attract attention. Enquiry should be made as to the existence of any discharge from the nipple, and as to the character of the fluid, whether milky, serous, bloody, or mucous. In reference to this symptom we may here pause to point out that a *discharge of milk* will generally be found only in association with the function of lactation; occurring, however, apart from that, and in association with a tumour, it is strong evidence of the glandular nature of such a growth. A thin *serous or bloody discharge* is frequently noticed in cases of cancer. A *discharge of mucous fluid*, whether clear, green, red or dark brown in colour, points to the presence of glandular cysts in the breast.

Having examined the breast, the surgeon will next carefully **explore the axilla** to determine whether there is any enlargement of the lymphatic glands, one or more, and if so, whether they are hard, matted together, adherent to the skin, the chest wall, or the axillary vessels and nerves, or ulcerated; and then he should pass his hand up to the neck and feel in the posterior triangle for any similar enlarged glands in that region. It is necessary to observe that unless care be exercised enlarged glands may be overlooked; and the writer has known them mistaken for the ribs, and *vice versâ*. Ordinary care and anatomical information should render impossible such an error. The skin over the breast and beyond it is sometimes specially affected, being beset more or less closely with firm nodules, which run together and form thick indurated plates over the chest, which may then ulcerate.

In regard to the history of the case, the first point to ascertain is the patient's age when the tumour was first noticed, and whether the patient was at that time pregnant or suckling, or whether the tumour followed a miscarriage, weaning, a blow, or arose spontaneously, quite independently of any functional activity of the gland or of injury. Cancerous tumours are hardly known before the age of thirty, and they do not, as a rule, arise during pregnancy or lactation. They are, *par excellence*, the tumours associated with the involution of the gland. Milk cysts are only met with in connection with lactation; other forms of cysts are formations apparently as closely associated with middle and late life as is cancer; while the more benign tumour, fibroma, is met with in early life. Some chronic abscesses are especially met with following functional stimulation of the gland. The rate of growth is an important indication of the malignity or the reverse of the growth.

Lastly, it must be remarked that at present it is impossible, without microscopical examination, to distinguish between all pathological varieties of neoplasm, and that a careful consideration of all the facts may leave the surgeon in doubt as to the nature of a growth; in some of these cases an exploratory puncture may clear up the diagnosis. The tumours may be classified into those which fluctuate over their entire surface, those which fluctuate in places only, and those which are wholly solid.

The tumour fluctuates.

(1) If the swelling have arisen during pregnancy or lactation, be globular in outline, and uniform in consistence, without any signs of inflammation, it is a *galactocele* or *milk cyst*. These tumours are usually painless, and if allowed to remain until lactation ceases, they may undergo a little shrinkage from absorption of some of the liquid parts of the milk.

(2) A single ovoid or globular, wholly fluctuating tumour, not very tense, of slow painless growth, not yielding to pressure, or accompanied by a mucous discharge from the nipple, is probably a *serous or lymphatic cyst.*

(3) If the swelling be firmly fixed in the breast, occupying the periphery, and perhaps an entire lobe, somewhat uneven on the surface, and tense; and especially if there be a discharge of discoloured mucus from the nipple, or if such fluid escape when the swelling is compressed, it may be diagnosed as a *mucous cyst.* These cysts vary much in size, they may be very small, and then are frequently multiple, and are difficult to diagnose or even to detect; they do not become adherent to the skin or pectoral muscle, or cause retraction of the nipple or enlargement of the lymphatic glands.

(4) A slowly-growing globular, tense, fluctuating tumour, movable in the breast, may be an *hydatid cyst.* This diagnosis would only be rendered certain by an examination of its contents, and the detection of "daughter cysts," or hooklets.

(5) If the fluctuating swelling be attended with redness of the skin over it, or superficial œdema, and be surrounded with an ill-defined indurated margin, it is a *chronic abscess.* Of this there are two varieties. One is met with in strumous persons quite independently of functional activity of the gland, the abscesses having all the characters of *strumous* abscesses generally, and frequently being multiple. The other form occurs in connection with pregnancy, after miscarriage, or after weaning, and from the indurated wall and the obscurity of the fluctuation, the diagnosis may be very difficult; but whenever an ill-defined hard lump is met with in the breast after pregnancy or lactation, the probability of its being a small chronic abscess should be well considered; these abscesses also may be multiple.

The tumour fluctuates in places only, or is partly fluid and partly solid. In these cases the presence of the cyst or cysts is of only secondary importance, and the diagnosis rests mainly upon the characters of the solid portions of the growth.

(1) If the tumour be of small or moderate size, and of slow growth, it may be diagnosed as a *fibro-cystic tumour.* Such tumours may arise as mucous cysts, in which intracystic papillomatous growth has occurred, and when there is a history of a mucous discharge from the nipple, this will be the most probable diagnosis.

(2) If the tumour be of large size, of rapid growth, and infiltrate the breast, the skin over it being thinned, with large blue subcutaneous veins showing through it, it is a *cystic sarcoma.*

The tumour is solid throughout.—First determine whether the lump moves freely in the breast, under the skin and over the pectoral muscle; then notice its outline and consistence, whether the axillary glands are enlarged, and whether the skin is affected.

(1) If the tumour be freely movable in the breast and under the skin, with a clearly defined outline, and be firm and rounded, of slow painless growth, and the nipple and lymph glands are unaffected, it is a *chronic mammary tumour.* If occurring in a young woman it is a *fibroma,* while if met with about middle age, and preceded by a discharge from the nipple, it may be an *adenoma,* but this is a rare form of tumour. More than one of these tumours may be met with in the breast, and hence there may be an apparent recurrence after removal of the primary growth.

(2) If the tumour be freely movable over the breast and under the skin, and be soft, lobulated, with a shallow rounded smooth edge, and especially if the skin be dimpled over it, the surgeon will recognise a *lipoma.*

(3) If the tumour be freely movable under the skin and in the breast of great firmness, with a rounded lobulated or bossed outline, and if it be of very slow growth, it may be an *enchondroma*; but as this

neoplasm is only very rarely met with in the breast, the diagnosis between it and a firm fibroma will probably not be made before removal of the tumour.

(4) If the tumour be fixed in the breast, being immovable apart from the gland, be of great hardness, with somewhat ill-defined edge, of steady or rapid growth, and, if the tumour be of some size or situated towards the front of the mamma, if the skin be adherent to it and puckered in, or the nipple retracted, and one or more of the lymphatic glands in the axilla be enlarged and hard, it is a *scirrhous cancer*. As this is the variety of tumour of which the diagnosis is of most moment, it may be further pointed out what are the features to be specially recognised. (*a*) The first and most important of these is the *infiltrating mode of growth* of the tumour; beginning in the gland, it is from the first absolutely fixed in it and immovable apart from it, and as it enlarges it infiltrates and becomes fixed in a similar manner to the skin over it and to the chest muscles beneath it, but these latter phenomena are observed only when the tumour has reached a certain size. Whenever this characteristic is well marked, scirrhus must be diagnosed unless absolutely contraindicated.

(*b*) *Contraction* of the growth, leading to dragging upon the galactophorous ducts and retraction of the nipple, and also puckering in of the skin over the tumour; in some cases this feature is very marked, and is then very characteristic.

(*c*) *Glandular infection*, occurring early and very constantly. The affected glands, like the primary tumour, are hard and progressively enlarge. The glands are also found enlarged in acute and sometimes in chronic abscess.

(*d*) *Age.* The disease is scarcely known before thirty years of age, and commences most often during and after the climacteric period. In addition to these four signs, which may be called the cardinal signs of scirrhus, there are other phenomena of less constant occurrence, but of equal diagnostic value when observed. Of these may be mentioned especially

(*e*) *Paget's disease of the skin.*—When a tumour is found in the breast associated with, and developed subsequently to, this form of chronic incurable eczema, it may with certainty be diagnosed as scirrhus.

(*f*) *Nodular growths in the skin.*—A diffused eruption of firm nodules in the skin, which run together and convert the skin of the breast and chest into a tough inelastic hide, is an eminently characteristic form of scirrhus.

(*g*) *Discharge from the nipple,* when associated with a wholly solid form of tumour, is said by Gross to be peculiar to cancer; it is a not infrequent symptom, the discharge being usually of a serous character, mixed with blood.

(*h*) *Ulceration* may be a striking feature, and the point to which attention should be directed is as to whether the skin is implicated in the growth before it breaks down, or whether, from pressure upon it, a portion of it sloughs, and on the separation of the slough the subjacent tumour fungates. This can be readily ascertained from the character of the edge of the ulcer. Where the edge is thin and not adherent to the fungating growth, it is certainly not cancerous; but where the edge of the ulcer is formed by infiltrated livid skin continuous with the ulcer it denotes that the growth is cancerous. The rapidity and extent with which ulceration occurs vary greatly in different cases.

(*i*) *De Morgan's spots.*—The late Mr. Campbell de Morgan pointed out the great frequency with which certain bright-red nævoid spots occur in the skin in cases of cancer; they are found in other circumstances, but are more frequent and more numerous where cancer is developing; they are therefore of some slight value in diagnosis.

The facts in relation to heredity, pain and cachexia are not of a nature to aid materially in the diagnosis in cases otherwise obscure. Scirrhus occurs in the breast in several forms, and the following varieties at least can be clearly recognised:

(α) The *tuberous*, in which a distinct tumour is developed which grows steadily, and in which the progressive new formation is the most characteristic feature.

(β) The *ulcerative*, in which the growth quickly and widely ulcerates, often forming huge chasms.

(γ) The *cicatricial*, which is characterised by very slow growth, a prolonged course, and the very great contraction of the growth, which draws in towards itself all the surrounding parts, making a deep pucker in the breast or chest.

(δ) "*Scirrhe en cuirasse*," in which the growth occurs mainly and widely in the skin, in the form of widely-scattered nodules, which spread and run together into an unyielding cuirass-like casing of the chest.

(5) If the tumour infiltrate the breast, be more or less globular in outline and soft in texture, of rapid and constant growth, forming adhesions to the skin, which quickly ulcerates, allowing the tumour to fungate, with early enlargement of the lymphatic glands, it is *encephaloid cancer*.

(6) If the tumour infiltrate the breast, grow steadily and perhaps very rapidly, if it be of globular, lobed, or irregular outline, not adherent to the skin or chest wall, and there be no enlargement of the lymphatic glands in the axilla, it is a *sarcoma*. The firmness and rapidity of growth of these tumours vary greatly; when of large size the skin over them ulcerates without being actually infiltrated by the neoplasm, and the edge of the ulcer is formed by thin undermined and adherent skin.

(7) If a soft tumour develop rapidly in the breast of a woman of about forty-five years of age, and do not become attached to the skin over it or to the chest wall, or infect the lymphatic glands, it is probably a *myxoma*.

CHAPTER XXXIII.

DIAGNOSIS OF DISEASES OF THE ABDOMINAL WALL.

WHILE many of the diseases of the abdominal wall are readily recognised by the features common to them here and in other situations, others are peculiar to this region or present special difficulties in diagnosis, and require from us separate consideration. The first of these is a small group of *congenital malformations of the umbilicus*, of which *hernia* (*see* page 464) is the most common. A bright red fleshy wart-like growth at the umbilicus, presenting a smooth and vascular surface, is a *polypus or papilloma*. It commonly has a short central canal in it. Should the umbilicus be excoriated and a watery fluid escape from it, this is probably urine flowing through an *urachal fistula*. The detection of urea will at once determine that the fluid is urine. The urethra should then be examined for stricture. Congenital *fæcal biliary or gastric fistulæ* are sometimes met with. Where there is a direct communication between the skin and the intestine so that the mucous membrane is continuous with the skin, it is spoken of as an *artificial anus*. The surgeon will know by the reaction and appearance of the discharge what part of the alimentary canal is opened. Where a plastic operation for the cure of artificial anus is in contemplation the surgeon should look carefully for a "spur" of the intestine, which projects into and sometimes blocks up the lumen of the tube. The "spur" should be carefully examined to ascertain whether there is a coil of intestine protruding behind it; this can be felt, or on manipulation a gurgle may be detected. A *fæcal fistula* may be met with in any part of the abdominal wall.

A simple *sinus* may be met with as the result of an abscess in the belly wall, or in the abdominal cavity; the history of the case and careful probing will determine the diagnosis.

Tumours of the abdominal wall are to be distinguished from tumours of the abdominal cavity by their mobility with the belly wall; abdominal tumours may be movable, but independently of the tissues over them: in some cases tumours beginning in the abdominal wall grow into the cavity and become adherent to the viscera, and it is important to recognise this condition. The most common tumours are *herniæ*, umbilical or ventral (*see* page 286); *lipoma*, *abscess*, and *epithelioma*. (*See* page 337.) *Epithelioma of the umbilicus* rapidly spreads into the peritoneal cavity and forms secondary growths in the omentum.

Abscess in the abdominal wall may be *superficial* or *deep*; the former is easily diagnosed by the fluctuation and the signs of acute inflammation. *Deep abscess* may form in the *sheath of the rectus* muscle or *underneath the muscular aponeuroses.* If a tumour with the signs of inflammation (pain, tenderness, heat, and redness) form in the belly wall, and its outline correspond to one of the divisions of the rectus muscle, it is an *abscess in the sheath* of this muscle; fluctuation is very difficult to obtain in acute abscess, and the induration and surrounding œdema are marked; in chronic abscess, induration and œdema are absent and fluctuation is more distinct. These abscesses are to be distinguished from pointing intra-abdominal abscesses by the absence of an expansile impulse coughing, and by the entire irreducibility of the swelling by pressure. Great care is required to distinguish the thrusting impulse of all swellings in the abdominal wall from the increased tension and filling out of the tumour, which characterise fluid swellings of the cavity extending into the walls. The *subaponeurotic abscesses* can be distinguished from localised collections of pus in the peritoneal cavity only by operation; a previous history of fever is a point in favour of intraperitoneal suppuration.

CHAPTER XXXIV.

DIAGNOSIS OF CASES OF INTESTINAL OBSTRUCTION.

THE first step in the investigation of cases of intestinal obstruction is to learn exactly the mode of onset of the symptoms, for such cases naturally group themselves into two classes, the *acute* and the *chronic*. In the one class, the patients state that having been in their usual good health, with regular performance of digestion and defæcation, they have been suddenly seized with pain in the belly, absolute constipation (not even flatus being passed), and vomiting, and the surgeon finds them in a state of more or less well-marked collapse; the most familiar example of such cases is afforded by a strangulated hernia, and they are well known as cases of *acute obstruction*. On the other hand, patients present themselves with a history of long-standing trouble with their bowels, constipation with or without diarrhœa at times, lessening size of the motions passed and increasing discomfort in the belly, at length culminating in complete obstruction (though often flatus is passed), inappetence, wasting, and vomiting; cases of cancer of the rectum afford the best example of this *chronic obstruction.* We must consider the diagnosis of these two classes of cases separately.

Acute intestinal obstruction. — Having arrived at the conclusion that the patient is suffering from *acute obstruction*, the first step in the diagnosis is to determine whether there is any *external hernia.* The usual and also the unusual seats of hernia must each and all be carefully examined with this view; and if a tumour be found, which is fixed to the belly-wall, tense, painful and tender, and dull on percussion, it is to be regarded as a *strangulated hernia.* Should the surgeon be in doubt as to whether a given swelling is a hernia or not, when there are symptoms of acute obstruction he should at once explore the nature of the swelling by operation. If no hernial tumour be detected, inquiry should be made as to whether the patient is the subject of a hernia which has been reduced, and if so, what relations as regards time the onset of the symptoms of obstruction had to the reduction of the hernia, and whether the reduction offered any difficulty. It must be remembered that a patient may himself accomplish a *reduction en bloc* of a hernia, and the author lately saw a case in which this had happened, although the patient had not noticed any difficulty whatever in the taxis. When, then, it is known that the patient is the subject of a reducible hernia, the ring and hernial canal should be very carefully explored, and it may even be justifiable to try to get the rupture to descend to make certain that it is not the seat of the obstruction.

If the surgeon is able to exclude altogether external hernia, the problem then is to distinguish between the various forms of INTERNAL STRANGULATION In a large number of cases it is impossible to determine the exact cause of the strangulation without actual exploration of the abdominal cavity; *intussusception* is capable of more certain diagnosis than any other form of acute internal strangulation. Where, early in the case, the collapse is very marked, the pulse being small and feeble, and the skin cold and bathed in sweat, it indicates *tight strangulation.* When vomiting sets in early, is frequently repeated, and quickly becomes stercoraceous, and the belly is uniformly and only moderately distended, and the excretion of urine is small, the obstruction is known to be seated in the *small intestine,* and the higher up the strangulation the more marked are these distinguishing features. Where, on the other hand, the abdomen is greatly distended, and the vomiting is less urgent, and a longer interval elapses before it becomes stercoraceous, it indicates that the obstruction is in the *large intestine.* In these cases it may be possible to see or to mark out by percussion the cæcum and colon, and where the obstruction is in or near the transverse colon the right loin may be much more distended than the left. Three chief forms are to be distinguished: *intussusception, internal hernia,* and *volvulus. Intussusception* is most common in children, but is not limited to them. Its signs should first of all be sought, as it may admit of other than operative treatment. Note the time at which vomiting set in, its urgency, and how soon, if at all, it became stercoraceous; estimate the collapse of the patient, and then examine the amount of distension of the belly, and whether it is uniform or localised. Then feel carefully for a tumour or undue resistance, especially in the right iliac and lumbar regions. Observe whether there is any discharge from the anus, and then pass the finger into the bowel to feel for intussusception, for pelvic tumour, for an obturator hernia, or for coils of collapsed intestine fallen into the pelvis.

In cases of acute internal obstruction there is no advantage for purposes of diagnosis to be derived from the administration of copious or repeated enemata, or from attempts to pass a long rectal tube.

If an elongated tumour be felt in the position of the cæcum, or in the course of the colon, and if there be frequent tenesmus, and a discharge of bloody mucus, or even of pure blood from the anus, *intussusception* is to be diagnosed. In some cases the lower end of the strangled bowel may be felt in the rectum, or it may be even extruded beyond the anus. If the patient have been suddenly seized with localised pain in the belly which has rapidly become greatly distended, and a rounded tense swelling or tumour can be detected in either iliac fossa or flank, it may be diagnosed as a *volvulus.* This condition is met with more frequently in the large than in the small bowel, and particularly in the sigmoid flexure, and the twisted part may become enormously distended, and be plainly perceptible through the abdominal walls. When there is but moderate distension of the abdomen, and no tumour or swelling or seat of special resistance can be detected, and further where the vomiting sets in early and quickly becomes stercoraceous, it may be diagnosed as an *internal hernia* or strangulation of the bowel by a band. This diagnosis acquires greater probability if there is an old hernia, or if there is a history of some previous attack of peritonitis, or of an intraperitoneal operation such as ovariotomy, or if the patient has been subject to attacks of colic.

If a patient who has been suffering from jaundice, pain in the hepatic region, sickness, and other signs of gall stone, suddenly exhibit signs of acute intestinal obstruction, it may be attributed to *impaction of a gall stone.* These cases are usually rapidly fatal.

Chronic intestinal obstruction. — Whilst the first class of cases which we have just been considering consisted of those in which a part of the bowel is strangulated, this is made up of cases in which there is simply an obstruction to the passage of the intestinal contents. This condition is most frequent in the large intestine, and particularly near its lower end.

The surgeon should first of all obtain an accurate history of the case, noting particularly the duration of the symptoms and the character of the evacuations. The symptoms may indicate merely an exaggeration of a condition of constipation, the motions being hard and lumpy, or even of their normal size. Or there may be a gradual march of the symptoms with lessening size of the motions down to marble or pea-like lumps, and these may be mixed with abundant mucus or blood, and if the quantity of mucus be great it may be discharged frequently, and give the patient the impression that he is really suffering from diarrhœa. In rarer cases there may be a history of gall stone, or of a previous attack of chronic peritonitis which has gradually interfered with the peristalsis of the intestine. Having investigated the history of the case, the surgeon should proceed to the examination of his patient. This should consist first of all of an exploration of all the seats of hernia to exclude that source of obstruction. Then the rectum should be examined to exclude pressure upon or stricture of this tube, intussusception, and impaction of fæces, a gall stone, or any foreign body. (*See* page 169.)

If the disease be still undetected, the belly must be examined to notice the amount of distension, and whether this is uniform or localised. This was referred to in the last section, and its bearing upon diagnosis pointed out. Of course an abdominal tumour will be diligently sought for, and if such be found, all its features will be carefully noticed. The belly will then be examined, to determine, if possible, where the obstruction is. By percussion it may be possible to map out the distended colon, and to determine that only a part of it is distended. Further, the age of the patient and his general constitutional condition must not escape observation.

If the patient be otherwise in good health, but pass a hard motion only at long intervals, the motion being dark in colour and of normal size, and the rectum be found healthy and empty, the belly not greatly distended, nor containing a tumour, and particularly if the patient be an anæmic young woman, it may be considered as a case of *atony of the bowel.*

If with symptoms like the above the rectum is found full of hardened fæces, or similar fæcal masses can be felt in the colon, it is usually spoken of as a case of *fæcal impaction.* The two cases have very much in common. In fæcal impaction the patient may pass even daily small hard lumps of fæces, or be troubled with tenesmus and a frequent evacuation of mucus stained with fæces. This condition is often met with in elderly people.

If with the signs of chronic obstruction an elongated tumour is felt in the belly, and the patient discharge mucus with a small amount of fæcal matter from the rectum, and complain of irregular colicky pains and tenesmus, *chronic intussusception* is to be diagnosed. The end of the intussuscepted length of bowel may be felt in the rectum.

For the diagnosis of *simple* and *malignant stricture of the rectum, see* page 487.

If these causes can be excluded, the surgeon must attempt to determine by the amount and character of the abdominal distension whether the obstruction is seated in the large intestine or in the small. Malignant disease is much more frequent in the large than the small bowel, while chronic peritonitis or adhesions or traction most often affect the small intestine. If a tumour can be detected through the abdominal wall it is of great value in the diagnosis. By listening over the cæcum while a large enema is being administered it may be possible to hear whether the fluid reaches the cæcum, or to make out where its passage is blocked. By the introduction of the hand into the rectum and colon an obstruction, otherwise obscure, may be detected. (*See* page 483.) If the signs point to obstruction in the small intestine, and there be a history of previous peritonitis, or of pelvic inflammation or tumour, and the constipation be not absolute, the condition may be attributed to *chronic peritonitis,* or some similar cause dragging upon or binding down the intestine and impeding its peristalsis. Where, however, the obstruction is seated in the large intestine, and the disease has steadily and continuously progressed, whether a tumour can or cannot be felt, it must be attributed to *cancer of the colon.* The signs of obstruction will probably be combined with mucous or bloody diarrhœa, rapid emaciation and progressive anæmia. Secondary deposits may be detected in the liver and elsewhere.

Diagnosis of cases of congenital intestinal obstruction.—Whenever a new-born infant does not pass the meconium within twenty-four or forty-eight hours, it should be carefully examined to ascertain whether there be not some deformity of the lower bowel. Vomiting and abdominal distension are other symptoms calling attention to this condition. The surgeon will have to ascertain three facts: whether the anus is developed, whether the rectum is developed, and whether the rectum has formed any unnatural communication with the bladder, uterus, or vagina. By inspection of the perineum it will be at once obvious whether the *anus is developed* or not. Having ascertained this point, the surgeon must try to determine whether the rectum is developed. Passing his little finger into the anus he feels for a tense bulging swelling filling out the pelvic cavity; this may be felt separated from the anus by a thin septum, or at a greater distance; or, on the other hand, the finger may quite fail to find any such swelling in the pelvis. If there be no anus, the surgeon feels carefully in the perineum and notices whether it bulges when the child cries or strains, or when pressure is made upon the hypogastrium and iliac fossa; by such signs the distended rectum may be diagnosed. If, however, the perineum be hollow, and there be no evidence of the presence of a distended rectum, the surgeon should make an incision in the median line in the normal position of the anus, and carefully dissect up along the front of the sacrum, endeavouring to feel for the swelling of the distended bowel. Communication of the rectum with the bladder or urethra, or with the vagina, will be shown by the escape of the meconium in the urine, or from the vulval orifice. The author once met with a case, which he believes to be the only one of the kind recorded, in which the obstruction was due to a plug of inspissated mucus in the lower end of the ileum.

CHAPTER XXXV.

DIAGNOSIS OF ABDOMINAL HERNIA.

THE phenomena of hernia vary so much in different cases that there are only three features common to it in all conditions. These are (*a*) the presence of a tumour; (*b*) its connection with the abdominal cavity; (*c*) the fact that it has suddenly or gradually appeared as a protrusion from the belly. In the great majority of cases we find the tumour at one or other of the favourite seats of hernia, and learn that it is or has formerly been reducible with reappearance of the tumour under effort or strain, and we are able by the characteristic feel of the tumour, by tympanitic percussion, or by a gurgle in it, to demonstrate that its contents are one or other of the abdominal viscera.

Diagnosis of the anatomical varieties of hernia.—All scrotal and labial herniæ descending from the groin are *inguinal*. A hernia occupying the fold of the groin may be either inguinal or femoral. Abduct the thigh and make the adductor longus tense, and then run the finger up along it, to the pubic spine; if, now, this point of bone be internal to the hernia it is *femoral;* if external, the hernia is *inguinal*. In men the surgeon should push his forefinger into the bottom of the scrotum and up along the cord to the external abdominal ring and inguinal canal, when he will be able to feel whether the tumour occupy that canal or not. If the hernia be distinctly below Poupart's ligament it is *femoral*. A small hernia lying in the inguinal canal is called a *bubonocele*. A hernia at or close to the umbilicus is known as an *umbilical* hernia; when congenital the protrusion is through the umbilical orifice; in later life the "ring" is often an aperture in the linea alba close to this. A hernia protruding at any other part of the abdominal wall is known as *ventral;* these occur at the seat of old cicatrices or muscular ruptures, and differ from other herniæ in having no "neck" to the sac.

Should a hernial tumour be found below Poupart's ligament, to the inner side of the femoral vessels and deep among the adductor muscles, it is an *obturator* hernia. It is rare for this variety of hernia to form a distinct tumour; there may be nothing but a slight sense of resistance deep down beneath the pectineus muscle, with tenderness on pressure at this spot, eversion of the hip causes pain shooting down to the inner side of the knee. A careful examination of the inner aspect of the obturator ring should be made from the rectum or vagina. Other rare forms of hernia are *vaginal*, *pudendal*, *perineal*, and *ischiatic*.

Inguinal hernia.—Whenever a hernial tumour of some size is suddenly produced, its sac has been preformed; where, on the contrary, the hernia has been slowly produced, its sac has been formed by a gradual protrusion of the parietal peritoneum. Any hernia, therefore, which at its first formation reaches into the scrotum has a preformed sac. If a scrotal hernia, which was suddenly formed, be found to completely envelop the testicle, it is a *congenital hernia*, or a hernia into the tunica vaginalis. If a suddenly-formed scrotal hernia extend to the top of the testicle, the testicle forming as it were a second tumour separate from and movable over the hernia, it is a *funicular hernia*, or a hernia into the unobliterated funicular process of peritoneum. Where an inguinal hernia has originated as a small protrusion which has gradually increased, it is an *acquired* hernia; when of large size in the scrotum the testicle will be found behind the hernia; this form may be "*oblique*" or "*direct.*" To distinguish between an *oblique* and a *direct hernia* look at and feel the direction of the swelling in the abdominal wall, and then reduce the hernia, and, putting the finger in the canal, get the patient to cough and notice where the protrusion of the gut is felt. When the neck of the hernia forms an oblique swelling in the groin, and especially when its first protrusion is felt to be outside the external abdominal ring, the hernia is *oblique*. As an oblique hernia when old and of large size becomes direct, it is only possible to distinguish between them when recent and of small size. When such a hernia is felt to protrude immediately behind the external abdominal ring it may be diagnosed as *direct*. Congenital and funicular hernia are always oblique.

Diagnosis of the contents of a hernia.—If a hernia be tympanitic on percussion, smooth, rounded, and elastic, yielding a gurgle on manipulation, it is an *enterocele*. When it is dull on percussion, firm, lobulated and not yielding any gurgle, it is an *epiplocele*. But if in places it be tympanitic on percussion and soft and gurgling, but in others firm and lobulated, it is an *entero-epiplocele*. When part of a scrotal hernia is found to fluctuate, and on pressure urine is evacuated or the patient experiences a strong desire to micturate, the surgeon may diagnose a *cystocele*. This form of hernia is rare in the male, and quickly becomes "irreducible"; in the female, under the form of a vaginal protrusion it is more common.

Reference may here be made to the diagnosis of *umbilical epiplocele*, which has to be distinguished from a subcutaneous *lipoma* and an outgrowth of *subperitoneal fat*. All alike consist of soft, rounded, lobulated masses of fat. If the tumour be freely movable in the belly wall, quite irreducible and without an expansile impulse, it is a *subcutaneous lipoma*. If the tumour on its deep aspect be fixed to the belly wall, be not and never have been reducible, and have no impulse on coughing, it is a *subperitoneal lipoma*. If the tumour be fixed deeply to the belly wall, and be or have once been reducible wholly or in part, and have an expansile impulse on coughing, it is an *epiplocele*. It may be impossible to distinguish between the last two tumours without operation.

Diagnosis of pathological varieties of hernia.—1. If the hernial tumour entirely disappear on lying down or on gentle taxis, slipping up with a gurgle and redescending on coughing or assuming the vertical position, it is a *reducible hernia.* After reduction the surgeon can feel the sac of a hernia as a more or less marked thickening of the part, and also the canal or ring through which the hernia has passed.

Supposing the hernia or any part of it is not thus completely reducible the surgeon should learn the age of the hernia, how long it has been unreduced, whether it is now larger than usual, and, if so, whether that increased size is the result of a strain or effort, or is quite spontaneous. He should examine the tumour, noticing its outline, tension, and sensitiveness, whether there is any impulse on coughing, or fluctuation, and whether it is dull or resonant on percussion. He should inquire when a motion was last passed, and whether flatus has been passed since; if vomiting have occurred he should examine the vomited matter to estimate from what part of the alimentary canal it has been regurgitated, and he should also learn the frequency of the vomiting, and examine the belly for distension and tenderness. Finally, he should investigate the patient's general condition, pulse, temperature, tongue, facies, and urine.

2. If the hernial tumour be free from all signs of inflammation or tension, have an impulse on coughing, and there be no signs of intestinal obstruction, it is a *simple irreducible hernia.* If there be a history of attacks of pain in the hernia, there are probably adhesions in the sac. If there have never been such attacks of pain, but the patient have become stout, it is probable that the increased bulk of the contents (epiploon or mesentery) has led to the irreducibility.

3. If there have been a sudden formation of a hernial tumour or a sudden enlargement of an old hernia from some strain or effort, and if the tumour be

tense, dull on percussion, and perhaps fluctuating, tender, and sometimes acutely painful, without impulse on coughing; and if there have been absolute constipation, not even flatus having been passed since the occurrence of the increased swelling, and vomiting, first of food, then of bile, and latterly of stercoraceous matter; and if with this the patient be found more or less collapsed, with cold skin, pinched features, rapid small pulse, tongue brown with a tendency to become dry, the hernia is *strangulated.* In some cases the pain and local tenderness are very marked, in others hardly noticeable; the vomiting may be very urgent or less severe, and the signs of collapse may be slight or intense; the local changes in the hernia together with the absolute obstruction, the vomiting and the collapse, usually render the diagnosis unmistakable. When the parts around the strangulated hernia become swelled, purplish, and œdematous, and the vomiting ceases and is replaced by hiccough, the patient becoming cold, livid, and very collapsed, *gangrene of the hernia* is to be diagnosed. Should a patient with an unrelieved strangulation suddenly complain of acute pain in the belly, and the collapse be notably increased, and this be quickly followed by distension of the belly, pain in the back and great abdominal tenderness, *extravasation of fæces and acute peritonitis* must be diagnosed.

4. If an irreducible hernia be of larger size than usual to it, heavy and full, but somewhat tympanitic on percussion and gurgling or pitting under the fingers, with a slight impulse on coughing; and if the surgeon find that there is no, or but slight, tenderness and no marked collapse, but a sense of fulness of the belly with nausea and vomiting when food is taken; and if there be a history of constipation for some time, or of a large and indigestible meal, and the bowels are confined although flatus may be passed, it

is an *obstructed hernia.* This condition is met with most often in large old irreducible herniæ, and in patients who are careless about the regular action of the bowels.

5. Whenever a hernial tumour shows signs of inflammation (redness swelling, local heat, pain and tenderness, with fever), it is an *inflamed hernia.* This may be due to local peritonitis set up by injury, to obstruction, or even to strangulation and sphacelus of the contents of the sac: in all cases the cause of the inflammation must be ascertained.

Diagnosis of the effects of taxis.—When, during taxis, hernial tumour yields with a sudden slip and a gurgle, and the contents then gradually pass into the belly and leave the canal clear except for the presence of the sac, the surgeon may be satisfied that the *hernia is reduced.*

Should the hernia yield gradually, go up bodily without a gurgle, and leave the ring unusually free, no sac being found in it, the surgeon must suspect *reduction en bloc;* and if, on pressing his finger well up into the canal, a sense of resistance is met with, or if the symptoms of strangulation persist, this diagnosis becomes established. Reduction *en bloc* may be very easily effected, even by the patient himself.

If, in attempting to reduce a hernia which has been some time strangled, the tumour be found to yield gradually under the fingers, but not disappear, and the outline and tension of the parts be altered, while at the same time the patient becomes profoundly collapsed, the surgeon is to diagnose *rupture of the intestine.*

After reduction of a hernia *peritonitis* may set in without rupture of the bowel. (*See* page 155.)

When after reduction of the hernia the pain referred to the umbilicus subsides, and the patient recovers from the collapse, but there is no passage from the bowels, and the abdomen becomes distended and there is localised tenderness, the surgeon is to diagnose *laming of the intestine* from the prolonged congestion.

CHAPTER XXXVI.

DIAGNOSIS OF THE DISEASES OF THE ANUS AND RECTUM.

It will be convenient to discuss very briefly the diagnostic value of the common symptoms of anal and rectal disease; but although this is done, it cannot be too clearly stated that in no case should a diagnosis rest upon such data, but that in every case a careful and thorough exploration of the parts is necessary; these symptoms may enable a surgeon to *guess* the nature of a patient's malady, but a careful examination will alone enable him to arrive at a *diagnosis.*

Pain is perhaps the most frequent of these symptoms. It may be an *itching* more or less severe, known then as *pruritus;* this is particularly associated with external piles, herpes, erythema or eczema of the anus or adjacent skin, external fistula, ascarides, constipation, and sexual irregularities. When *throbbing* in character it is generally due to acute inflammation and abscess, or to strangulation of prolapsed piles or mucous membrane. When *colicky* in nature and *preceding* and *accompanying defæcation,* it is generally caused by ulceration of the bowel. When of a dull *gnawing* character with exacerbations and continuing for a long period *after defæcation* it is caused by an irritable *ulcer* or *fissure* of the anus. Pain in the region of the *sacrum* is often due to malignant disease of the bowel, and when to it are added pains shooting down the thighs, it indicates that the disease is implicating the sacral nerves. *Tenesmus* is particularly caused by polypus and foreign bodies in the rectum, constipation, dysentery, stone in the bladder, or hypertrophy of the prostate.

Diarrhœa, in the sense of the passage of the intestinal contents too hurriedly, and in a too liquid form, is not a symptom of rectal disease; but in the sense of a too frequent evacuation of the lower bowel it is a common symptom of rectal ulceration which induces it, either by the active peristalsis excited by the contact of fæces with the ulcerated surface, in which case fæcal matter of usual consistence and size is passed frequently in small quantities along with much mucus, and with colicky pains; or by the amount of mucus, serum, or blood poured out from the diseased surface. A frequent discharge of mucus, mixed with more or less fæcal matter, may occur in cases of fæcal accumulation in the rectum. Indeed, this symptom is so frequently associated with rectal obstruction that it should invariably suggest to the surgeon the necessity of a thorough exploration of the rectum.

Constipation is quite as often a cause as a consequence of rectal trouble; it appears to induce piles, certainly promotes thrombosis in external piles, and increases the hæmorrhage from internal piles, and it is regarded as leading to anal abscess, to fistula, and to fissure. The affections of the rectum which lead to it are painful fissure of the anus (owing to the dread with which the pain of defæcation is regarded), stricture of the anus or rectum, and atony of the bowel by which its expelling force is diminished; this last, leading to impaction of fæces, may then set up a spurious diarrhœa. The association of "diarrhœa" and "constipation," by which is meant the frequent passage of fluid from the bowel containing no, or a mere minimum of, fæcal matter, is frequently met with, and should never be overlooked by the surgeon; it points to fæcal impaction, or to a tight stricture of the bowel. The shape of the motion passed is of little moment, as it is mainly determined by the contour of the anus; it may be flattened in stricture of the rectum or in enlargement of the prostate; it usually consists of small rounded lumps in cases of stricture; even the occasional passage of a full-sized motion excludes a tight stricture of the rectum.

Discharge.—*The time of its appearance:* if the discharge be constant and independent of the act of defæcation, its cause is extra-rectal, either mucous patches, eczema, and ulcer, or fistula; in the last case the discharge may be increased by the pressure of the fæces during defæcation. If, however, the discharge only attend an expulsive effort of the bowel, it comes from some intra-rectal affection, such as polypus, piles, internal fistula, fissure, ulcer, stricture; the only exception to this is seen in cases of very relaxed patulous anus where the sphincter muscle has so lost its power that the contents of the bowel can escape freely. The *nature of the discharge:* pure unaltered blood, in the absence of injury, points to internal piles, polypus, or to a ruptured varix or nævus of the rectum; hæmorrhage in a child is nearly always due to polypus, occasionally to intussusception; a streak of blood upon the motion is characteristic of anal fissure. A discharge of *altered blood,* brown or dark in colour, and having a peculiar penetrating fœtor, is met with especially in malignant disease of the bowel; *blood and mucus* mixed together may come from the congested mucous covering of an intussusception, or from a simple ulcer of the bowel. *Mucus* is discharged from the bowel in some cases of polypus and of ulcer, and also from internal piles, and from congested or chronically inflamed mucous membrane. *Pus* points especially to abscess or fistula opening into the bowel, to anal ulcer, and it is sometimes seen in cases of rectal ulcer. A thin *watery discharge* attends the disintegration of malignant growths, being often mixed with more or less broken-down blood. The escape of *gas* (not through the anus) felt by the patient as a fine crackling or bubbling, is a sign of a complete fistula, as is also the escape of fæces mixed with pus from a similar sinus. If a fistula discharge much pus it shows that its cavity is extensive; if the discharge be intermittent it often indicates the presence of diverticula from the main path of the fistula.

Protrusion from the anus, if constant, points to the presence of a malignant growth at the anus; if it only attend the act of defecation or other straining effort, it is more probably internal piles, polypus, or prolapse; the greater the ease and frequency with which the descent occurs the greater the probability of the affection being prolapsus, with or without either of the above affections superadded.

Before making a thorough and complete examination of the parts, the rectum should be cleared out by an enema carefully given, unless the symptoms point to a stricture; and where there is any reluctance on the part of the patient to submit to the examination, or a satisfactory examination cannot otherwise be made, an anæsthetic should be administered. This examination may be made in one of three positions: (*a*) with the patient lying on his side with the thighs well flexed and the perineum directed towards a good light; (*b*) with the patient on his back with the hips raised on a pillow above the level of the shoulders, and the thighs well drawn up and separated; or (*c*) in the case of men to whom an anæsthetic is not administered, the patient may be made to stand close against the back of a chair, and then bend down over it to the full extent; in this way the anus and the parts around it can be very conveniently explored, and if the patient be tractable the interior of the bowel can be readily examined.

The parts around the anus should first be explored by gently holding aside the gluteal folds; then the anus itself should be examined by everting its edge and getting the patient, if conscious, to "bear down" as in the act of defæcation; and lastly, the interior of the bowel should be examined by the finger, or the speculum, one or both. In many cases the surgeon should himself examine the evacuations of the bowel.

1. **Examine the parts around the anus,** noticing particularly any redness, swelling, ulceration, or discharge. If there be a diffused bright redness of the surface extending all around the anus, and on to the buttock, or forwards to the scrotum, without any swelling or discharge or pain other than itching, it is *erythema.* If in a young child, this is due either to want of cleanliness or to congenital syphilis, and the surgeon should look carefully for mucous patches here and elsewhere, and for other evidences of syphilis. In adults it is mostly seen in stout persons, and the part may be moistened with perspiration which cannot evaporate. If the surface around the anus be of a duller red colour, not swelled, but thinly covered with fine yellowish scales or scabs, it is *eczema.* If the redness be not in the form of a diffused patch, but of an annular eruption, and if it be chronic and attended with much itching, a portion should be well rubbed with glycerine, then a scraping removed and examined microscopically, a drop of weak solution of potash being added to clear up the specimen; and if bright highly refracting ovoid cells be seen (spores), it shows that the disease is parasitic erythema

or *erythema marginatum.* If there be a limited area of bright redness, which is swelled, very painful and acutely tender, it points to acute inflammation of the skin and subcutaneous tissue, and if fluctuation can be detected in it, it is an *abscess.* If the abscess be quite close to the anus and superficial, it is an *anal abscess;* if the swelling be deep, attended with much induration, and the finger introduced into the bowel feel the ischio-rectal fossa filled up, and fluctuation can be detected between the external swelling and the finger in the bowel, it is an *ischio-rectal abscess.*

If there are one or more circular or oval flat elevations of the surface, of a milky-white or opalescent appearance, with a moist smooth surface into which the probe does not sink, they are *mucous patches*, and the surgeon will, of course, look for other evidences of secondary syphilis. Finely papillated outgrowths from the skin, in between the branching divisions of which a probe sinks, are *warts. Sebaceous cysts, dermoid cysts, fatty tumours*, and *tumours growing from the coccyx* are occasionally found in this situation.

If small clear vesicles are seen, which either dry up into thin scabs, or burst and leave superficial abrasions, attended with much heat and itching of the part, they may be diagnosed as *herpes.* If, however, one or more sharply-cut ulcers be found with depressed greyish yellow base, examine the genital organs and the inguinal glands, and if similar sores be found on the genitals, or the inguinal glands be enlarged, painful, and tender, the sore should be diagnosed as a *soft chancre.* Soft chancres are rare in this situation, and the patients are generally women.

If a bead of pus or discharge be seen welling from a point of skin, a fine probe should be carefully pressed against it, and it will probably enter a sinus; or the opening of a sinus may be at once conspicuous, or may be found beneath a small firm elevation or fold of the skin. The surgeon having found a *sinus*, he must carefully pass a probe along it and determine its nature; if fæcal matter or flatus be seen or known to pass along it, or if the probe pass in towards the bowel and its point be felt by the finger in the rectum, it is a *complete fistula.* If, however, the probe pass towards the bowel but cannot be made to enter without forcing its way through the mucous membrane, and the finger in the bowel fail to detect any internal aperture of the sinus, it is an *incomplete external fistula.* The surgeon may find the probe pass circularly round the anus, or in more than one direction, showing that it is a *horse-shoe fistula*, or a *branching fistula.* But the thin skin quite close to the anus is so loosely fixed to the subjacent parts that the probe can be very easily made to pass beneath it round the anus when no sinus previously existed there; when the part is laid open by the knife, the difference between an old sinus lined by granulations on a base of firm fibrous tissue is at once distinguishable from the track a probe has forced for itself in cellular tissue. Fistulæ are often multiple, and their external orifices may be very small, even minute, far too small to admit a common probe; and where there is any constant moisture of the part or other sign of fistula, a most careful examination with a fine probe must be made and even repeated; the neighbourhood of small papular elevations must be specially explored, as the orifice of a fistula is often hidden in or under such a nodule. But the sinus may pass quite away from the bowel towards the sacrum or ischium, or up into the cavity of the pelvis, in which case bare bone, *necrosis*, or disease of the *sacro-iliac joint*, or of the *hip joint*, must be sought for. The examination of this region should be completed by the surgeon pressing with his finger on each side of and all round the anus; if he detect any unusual resistance or induration, and particularly if the skin over it be slightly reddened or livid he should suspect an *incomplete internal fistula.* By pressure pus may be made to ooze from the anus, may be seen flowing into the rectum when a speculum is passed, or the internal orifice may be felt and a probe passed into it and made to present under the skin; any one of these signs will make the diagnosis certain. *Ascarides* may be seen around the anus.

2. **Examine the anus.**—If the anus be found retracted and tightly closed by the sphincter with deep radial folds around it, the spasm is probably due to an irritable ulcer, and the patient should be encouraged to force down as in defæcation, and at the same time the surgeon should gently evert the opening, when a *fissure* will probably be seen with a small fleshy nodule of thickened skin at its outer end. This fissure is most common at the posterior border of the anus; there may be more than one. If the finger, well-greased, be now passed into the anus it may be able to detect a small soft depressed *ulcer* at the inner extremity of this fissure. The symptoms of this very important affection are severe gnawing pain during and especially after defæcation, the pain being in the anus, and spreading from it down the thighs, and a streaking of the fæces with pus or blood with a slight purulent discharge. Whenever there is severe pain after defæcation, or the passage of the finger into the anus causes acute pain, suspect fissure.

There is another condition liable to be mistaken for spasm, and that is *stricture of the anus;* in this the anus is not retracted, anæsthesia in no way lessens the resistance offered to the passage of the finger, and the rectal evacuations are always small. This is seen in children as a congenital affection, and in adults as the result of badly devised operations in which the cicatrisation of the wounds has narrowed the orifice.

Epithelioma of the anus may obstruct the outlet. Patulous anus, offering no resistance to the entrance of the finger, or to the escape of flatus, fæces, or discharge, may be the result of constant stretching of and pressure upon the sphincter by prolapsus of the bowel, or of operation, particularly of a double complete division of the sphincter, or it may be due to the presence of a stricture in the rectum of such a nature as to act the part of a sphincter.

Swellings at the verge of the anus must be carefully and critically examined. The lining of the orifice may be swelled more or less uniformly, of a somewhat bluish-white colour with very superficial abrasions, the condition being attended with itching and smarting; this is known as *eczema of the anus. Mucous patches* may be found at the verge of the anus resembling those seen on the skin around it. Of the remaining swellings, three forms of isolated, distinct little tumours must be distinguished. First and most common is a solid flaccid fold or tab of skin, incompressible, and not tender (*anal tabs*); then there are rounded, soft, smooth, compressible swellings of a bluish colour, which are dilated hæmorrhoidal veins covered externally by skin (*external hæmorrhoids*); the third form is a tense firm globular very painful and tender swelling, deep blue in colour on its innermost surface, with more or less redness and swelling of the skin; this is known as the *inflamed external hæmorrhoid;* it is a thrombosis of a hæmorrhoidal vein. The swelling, however, may take the form of an indolent infiltrating swelling without marked projection of the surface, and more apparent to touch than to sight. If it be an ill-defined thickening of the skin and subcutaneous tissues, indolent, painless, with slight livid red discoloration of the skin, or the skin be ulcerated with a firm yellowish-white [illegible]h forming the floor of the ulcer; or if there be independent ulceration of the bowel, *gumma of the anus* or *ano-rectal syphiloma* is to be diagnosed; a history or evidence of constitutional syphilis and the favourable results of treatment will afford substantial support to the diagnosis. If, however, the induration be more nodular, or assume the form of an ulcer, with thick everted edges, and depressed indurated uneven base, with small polypoid excrescences, and the inguinal glands be enlarged, and especially if the patient be past middle life and not the subject of constitutional syphilis, and the disease be unaffected by any medicinal treatment, and show no tendency to heal but steadily advance, it is *epithelioma of the anus;* this may extend up the rectum and form considerable masses infiltrating the bowel and obstructing the passage of fæces.

Lastly, the surgeon may find that there is a *protrusion from the anus;* or if none exist he may evert the orifice and get the patient to strain and see if this cause any protrusion; he must examine any such protrusion carefully to notice whether it consist of the everted mucous membrane of the bowel, and whether there is or is not a groove or sulcus between the protrusion and the anus. If the mucous membrane be directly continuous with the skin of the anus it is either simple prolapsus or prolapse of internal hæmorrhoids, and this must be decided by detecting low, soft, sessile, deep red or livid projections from the surface of the membrane, which prove the case to be one of *prolapsed internal hæmorrhoids;* if no such vascular outgrowths are seen it is a case of *simple or partial prolapsus.* If, however, the finger or a probe can be introduced into the rectum into a more or less deep sulcus around the base of the protrusion, it is a case of either complete prolapse or of polypus, and this can be decided by noticing whether there is an orifice at the extremity of the projection or not. If, therefore, the projection have an orifice at its extremity, be covered by normal mucous membrane, and project through the anus with a groove or sulcus running round between its base and the anus, it is a *complete prolapse* or *procidentia recti.* This will be distinguished from the *partial prolapse* or prolapse of mucous membrane only, by the sulcus round its base, by the fact that it is marked by circular folds in the mucous membrane, by its greater size, and often by its greater length; when of old standing, and one that has been habitually down, the mucous membrane becomes drier than normal, approaching the condition of skin. If the finger passed into the sulcus round its base can feel the reflection of the wall of the rectum on to the prolapse, it is usually called *prolapsus or procidentia*, but if the finger cannot reach the bottom of the sulcus, or feel this reflection, it is spoken of as an *intussusception.* When the projection is large the surgeon may be able to feel the gurgling of coils of small intestine within its anterior part. If two apertures are found close together at the extremity of the projecting mass, the case is known to be an intussusception starting at the ileo-cæcal orifice. In rare instances a stricture of the rectum may be forced down through the anus; the character of the orifice, its induration or ulceration, might indicate the nature of the case, but after reduction the diagnosis would be readily made. If the patient complain of severe pain and of inability to replace a projecting mass, and if it be œdematous and swelled, livid in colour, or perhaps even black and gangrenous in places, it is a *strangulated prolapsus*, in which strangulated internal piles may or may not be recognised.

Where the projecting mass is solid without any terminal orifice it will be recognised as a *polypus.* The most common variety of polyp is a bright red soft pedunculated growth, about the size of a cherry, found in children and young persons, consisting of adenoid tissue, and called the *glandular polyp;* it causes hæmorrhage, and is *the* great cause of hæmorrhage in children; it sometimes leads to the production of a fissure, and so may be associated with acute pain; when it is strangled by the sphincter ani it also gives rise to pain. Much more rare is a *soft fibrous polyp* formed of a pedunculated outgrowth from the mucous membrane like the common mucous polyp of the nose. *Firm fibrous polypi* are found only in adults in the form of smooth rounded growths with a slender, and often a long stalk. *Villous polypi*, recognised by their velvety surface, rarely protrude from the anus. *Cancerous* masses are recognised by their hardness, their association with ulceration, and the fact that they infiltrate the wall of the rectum. Polypi are to be distinguished from internal hæmorrhoids by their being more distinctly pedunculated, while piles are sessile, and also by the fact that their pedicle is attached above the sphincter ani; piles are anal growths, or if found higher up in the bowel are associated with similar growths at the anus.

The verge of the anus should be carefully examined for *fistulæ;* minute fistulæ in this situation are said to be not unfrequent in syphilitic disease of the rectum. Where a hæmorrhoidal tumour is found partly covered with skin, and partly with mucous membrane, it is spoken of as an *intero-external hæmorrhoid.*

3. **Examine the rectum.**—For this, the right forefinger should be well greased after the nail has been filled with soap, and gently introduced into the bowel, while the patient "strains down" to relax the sphincter muscle; in this way the tone of this muscle is at once determined. The finger should then be passed in to its full length, and gently swept round the

bowel, feeling especially for any narrowing of its calibre, any induration of its walls, and any breach in the smooth velvety mucous surface; by sweeping the finger round, a mucous or soft gelatinous polypus may be caught and felt, or even have its pedicle torn across. It is necessary to remember to use the utmost gentleness in this examination, especially where there is any ulceration of the surface, or stricture, as forcible pressure has been known to rupture the thinned and infiltrated bowel. Where a polyp is being sought for it is sometimes useful to have the patient standing up with his right foot raised on a high stool, and to make the examination in that position, as in that way the finger can reach higher than when the patient is recumbent. When the patient is anæsthetised, it is convenient to commence by dilating the sphincter, by inserting the two thumbs and separating them widely until the resistance of the sphincter is lost; by that means the interior of the bowel can be thoroughly explored, even without a speculum. In the male the prostate, base of the bladder when full, and the vesiculæ seminales, can be felt in front of the rectum; in the female the cervix uteri projects back towards the sacrum and is plainly felt through the rectal walls; in both sexes, the sacrum and coccyx are felt behind, and the ischial spines and tuberosities at the sides. These parts, either in their natural condition or enlarged, must not be mistaken for disease of the rectum. By means of a speculum the interior of the bowel can be examined with the eye, and the characters of any ulceration or new growth, or projection from the surface, as well as the condition of the vessels of the membrane can be determined. The base of all ulcers should be carefully explored with a probe to detect any sinus leading from them. Other means of exploring the rectum have been from time to time recommended, such as passing a bougie, or a bullet-probang, or inflatable balls of different kinds, for the purpose of the diagnosis of stricture of the bowel; none of these can be recommended, each may be productive of mischief, and may also deceive the surgeon by appearing to pass when really curling back, or by being arrested by a natural fold or bony prominence. The entire hand may be passed into the rectum and up along the colon; this can only be safely done when the hand is small and the introduction is accomplished very slowly and gradually.

It will be most convenient first of all to discuss the diagnosis of those lesions which are revealed by the speculum, but which are not detected by the finger. Immediately within the anus the submucous veins may be found congested, tortuous and enlarged, but visible as a venous plexus beneath the mucous membrane; this is best described as *hæmorrhoidal varix:* it is common, and gives rise to itching about the anus, sometimes to hæmorrhage, and may run on to the formation of piles. A *nævus of the rectum* may be met with as a livid raised soft compressible circumscribed swelling of the lining of the bowel; the only symptom it occasions is severe hæmorrhage from time to time; being a congenital disease it will be usually found in children and young persons; these two affections will be distinguished by the position of the dilated vessels, the diffuse character of the one and the circumscribed character of the other, and by the one forming a distinct soft bulging of the surface in which individual vessels are not perceived, while the other does not form a tumour, and individual veins are seen with clear spaces between them. A very different condition is that in which the mucous membrane is found of an uniform deep red colour without its normal glistening look, and is hot to the touch, and occasions an aching or burning pain to the patient, and an increased secretion of rectal mucus; this is *chronic catarrh* of the rectum; it has been spoken of as one form of internal hæmorrhoids, but is to be distinguished from that disease. Sessile deep-red projections from the mucous membrane are to be recognised as *internal hæmorrhoids;* these vary somewhat in appearance, some being very livid, others being of a bright red colour and bleeding very readily; they are usually too soft to be detected by the finger, but if of long standing and occasionally prolapsed and strangled, they may become firmer and distinctly palpable. The various forms of *polypi* already mentioned may be seen by the speculum; the *villous polypus* forming a sessile warty or papillated tumour, or consisting of numerous detached villi, and then called *polyadenoma,* will only be detected by this means of examination; it will be distinguished from cancer by the absence of induration of the rectal walls. The inner orifice of a *fistula* may be seen, and a probe introduced to detect the course of the sinus; generally the orifice will be felt. The surgeon will recognise two forms of blind or incomplete internal fistula, in one of which the sinus passes outwards under the skin causing some induration and lividity by the side of the anus; and in the other the probe passes up along the gut, either in the submucous tissue, or outside the bowel in the superior pelvi-rectal space; upon the thickness or thinness of the tissues overlying the probe in the sinus the surgeon will distinguish between the latter two. In some cases of *simple stricture* of large calibre, the finger fails to detect the narrowing owing to the absence of induration, but the contraction is rendered visible by the speculum, the size and shape of the opening as well as its lack of dilatability will at once enable the surgeon to diagnose it. The speculum will of course expose to view the anal fissures and irritable ulcers we have already mentioned.

The affections of the rectum which the finger detects may be grouped into ulcers and fistulæ, stricture and malignant disease of the rectum and new growths, etc., projecting into it.

An ulcer is detected by the absence of the perfect smoothness of the mucous lining of the bowel. The features to be specially recognised in reference to any rectal ulcer are (*a*) whether it is the internal orifice of a *fistula* (this can only be rightly determined by making an effort to pass a probe along it); (*b*) whether single or multiple; (*c*) whether attended with stricture or infiltration of the coats of the bowel; (*d*) and whether there is a history of syphilis or struma. The ulcer may be found on an internal pile or polypus from injury done in the act of defæcation. If the ulcer be single, circular in outline, without induration of its edges or base, and if the only symptoms to which it gives rise be the frequent passage of lumpy motions with excess of mucus and colicky pains, it is a *simple ulcer;* this is of the same nature as the irritable ulcer of the anus, and the nearer it approaches the anus the more pain does the patient experience. Such an ulcer found in a person known to be strumous is to be diagnosed as a *strumous ulcer;* this variety may be multiple, and there may be slight thickening of the edge of the sore; or the affection may be very chronic, and when it heals leaves bands of firm cicatrix narrowing the gut. If the ulcer be irregular in outline, with a sinuous sharply-cut edge, and be surrounded by a low flat ill-defined induration, it is a *syphilitic ulcer;* the surgeon will seek confirmation of this diagnosis in the history of the patient, in the existence of any other signs of late syphilis, and in the presence of irregular cicatricial narrowings of the bowel, or of small fistulæ opening at or close to the verge of the anus. *Soft chancres* and *phagedænic chancres* are occasionally met with in low prostitutes or the victims of pæderasty; the former are recognised by their sharply cut edge and depressed sloughy base, and by their being generally associated with similar sores around the anus and on the vulva; the latter is distinguished by the sloughy base and edge, and the extent and rapid increase of the ulcerated surface, *Hunterian chancre* may be met with in the rectum. and the induration of the edge and base together with the enlargement of the inguinal glands if the sore be at the anus, and of the pelvic glands if it be placed higher up, followed by the usual sequelæ, enable the diagnosis to be made. For the diagnosis of *cancerous ulcer* see below.

Lastly we must speak of the diagnosis of the conditions leading to narrowing of the calibre and induration of the walls of the rectum; these are often associated together and are recognised by the finger. The rectum may be displaced or compressed by swellings or other pathological changes outside it; the commonest instance of this is hypertrophy of the prostate, which is recognised as a firm rounded mass bulging into the front of the bowel and causing troublesome tenesmus; abscess of or around the prostate forms a fluctuating tumour in the same position, and malignant tumours may develop in this situation eventually infiltrating the walls of both the bladder and the rectum, and at their late stage not to be distinguished from primary cancer of the rectum. The enlarged vesiculæ seminales associated with strumous testicle bulge into the bowel higher up, and tumours springing from the pelvis may compress the bowel. In the female a retroverted uterus, or a tumour of the uterus or ovary, may have a similar effect. In both sexes, but more often in women, on account of the greater frequency of pelvic inflammation in that sex, the bowel may be bound down by firm fibrous adhesions. The surgeon will recognise these conditions by the position of the compressing masses, and the other signs and symptoms occasioned by them, and particularly by noticing that the rectal walls are not indurated or fixed, but glide more or less freely over the compressing structures.

If the surgeon find a firm nodular thickening of the mucous and submucous membrane without ulceration, or with ulceration just commencing, he should gravely suspect that he has to deal with a *commencing cancer*, and he should remove a small nodule for microscopical examination to render the matter certain. But if the surgeon find its walls infiltrated, thickened and hardened, of irregular contour, with puckered contractions and scattered ulcerations, he will diagnose *syphilitic stricture;* fistulæ which may open into the vagina or urinary bladder are common in this affection. A closely similar condition of the bowel is occasionally met with as the result of *dysentery* affecting the rectum; the diagnosis will rest upon the history, in the one case of syphilis, in the other of dysentery of long standing and marked severity. If the surgeon discover a hard nodular mass infiltrating and inseparable from the wall of the rectum, narrowing or even altogether occluding the canal of the bowel, and fixing the gut to the sacrum behind, or to the bladder or uterus in front; and if this mass continuously increase in size, be ulcerated on its free surface, with more or less of polypoid outgrowth from the ulcer, and be attended with pain in the sacrum, and frequent evacuation of mucus or of fœtid broken-down blood, a diagnosis of *cancer of the rectum* is to be made. This will be supported if the patient be over thirty years of age, if he be emaciated, pale, and sallow, if the pelvic glands be found to be enlarged, or if nodules of cancer can be felt in the liver.

The relative proportion of growth and ulceration differs much: in some cases the bowel becomes completely blocked by the nodular masses of growth, while in other cases the neoplasm quickly ulcerates, and the rectum may be then converted into a cancerous chasm with firm irregular walls, often extending into the bladder or uterus or vagina. Cancer is not unfrequently complicated with complete external fistulæ which may open into the bowel above or below the constriction; recto-vesical fistula will be recognised by the escape of flatus and fæces with the urine, associated with great pain during and after the act of micturition. Cancerous disease of the rectum is most commonly found about three inches from the anus, the rectum below it being healthy; but it may start at the anus and gradually spread up the bowel, or be met with at any higher part of the gut.

Of quite distinct appearance and nature is the remaining variety of stricture commonly spoken of as *simple stricture.* This is usually a circular or crescentic narrowing of the bowel, feeling like a ring or cord around it, lined with healthy mucous membrane, and situate about two inches from the anus, although it may be met with higher up. It is generally found in young persons, and in women more often than in men, and is considered to be due to a congenital malformation of the bowel; some simple fibrous strictures are probably due to the cicatrisation of a strumous ulcer. The simple stricture does not fix the bowel.

The finger may impinge upon an *intussusception* in the rectum; this will be distinguished from a polypus or other form of tumour by its characteristic shape, but especially by the orifice at its extremity; the symptoms attending it (a discharge of mucus or blood, tenesmus, colic, and intestinal obstruction) will also aid in the diagnosis.

The finger in the rectum will readily detect masses of *impacted fæces*, or *foreign bodies* that may have been swallowed or introduced through the anus. If after an enema have been given and returned the finger find the bowel empty, with its walls not collapsed, nor contracting upon the finger, a condition of *atony* of the bowel exists.

If after a thorough examination of the bowel no local lesion can be found, and the patient complain of severe burning, stinging or shooting pain of a paroxysmal nature in the bowel or anus, and if there be no disease of the urinary organs, nor tumour in the pelvis, and particularly if the patient be subject to neuralgia elsewhere, the affection may be described as *neuralgia of the rectum*. This must only be diagnosed after the most patient exploration under an anæsthetic has failed to reveal any local lesion.

The congenital deformities of the anus and rectum, with one exception, are all attended with a failure to pass the meconium, and have been considered in chapter xxxv. (page 462).

A congenital malformation, which may be overlooked for some time, is *narrowing* of *the anus;* in this case the meconium escapes, but after a time attentionis drawn to the fact that the fæces are passed with difficulty and that they are of very small diameter. The anus at birth should readily admit the surgeon's little finger.

CHAPTER XXXVII.

DIAGNOSIS OF DISEASES OF THE PENIS.

Diseases of the urethra are considered in chapter xlii.

The prepuce.—If the prepuce cannot be drawn back over the glans with ease and without pain the patient has *phymosis.* If, when the prepuce is drawn back, the glans be curved downwards, the *frænum* is too tight. If the prepuce be slit on its under side and cover the glans like a cowl, it is due to *hypospadias.* If the prepuce, having been drawn back, cannot be replaced over the glans, the condition is known as *paraphymosis*, and when the constriction of the prepuce is tight a roll of œdematous mucous membrane rises up behind the congested glans, and still farther back the skin of the penis is swelled, while between these two swellings deep down in a fissure is the tight margin of the prepuce. The prepuce is often too long, but if it can be properly retracted this condition is not phymosis.

Phymosis may be congenital or acquired. The *congenital* form is recognised by the history. The prepuce may be long, or altogether small, and tightly compressing the glans; but it is the condition of its orifice that is the important feature; this varies in size from a mere pinhole aperture to one which allows the prepuce to pass over the glans with difficulty. If a probe be swept round under the glans it will detect the presence or absence of *adhesions.* An old very tight congenital phymosis may lead to the dilatation of the prepuce into a kind of bladder. The author once circumcised a septuagenarian who presented this condition, the orifice of the prepuce being so small that it was only occasionally that a fine probe could be passed into it. Phymosis may be *acquired*, being caused by *œdema*, either inflammatory or as part of general dropsy, by *solid œdema*, by the induration of a *hard chancre*, by *adhesion* of the prepuce to the glans, by *cancer*, by *cicatrices* narrowing the orifice of the prepuce, or by *elephantiasis* or great *distension of the scrotum* by hydrocele, etc., dragging upon the sheath of the penis. Any one of these conditions may be combined with congenital phymosis. Acquired phymosis is often met with in morbus cordis and morbus Brightii, gonorrhœa, chancre, primary syphilis, and after the healing of chancres of the prepuce. Solid œdema or hypertrophy of the prepuce may be caused by constitutional syphilis.

When under a congenitally tight foreskin a lump of stony hardness is to be felt, it is to be diagnosed as a *preputial calculus;* if a probe be passed beneath the prepuce it gives a grating sensation as it touches the stone. These calculi are not to be confounded with the firm but yielding induration of a hard chancre, epithelioma, or gumma.

Discharge from the prepuce may be caused by balano-posthitis, urethritis, chancre, primary syphilis, epithelioma, or warts. Where the prepuce can be withdrawn the diagnosis is quite simple (*see infra*), but if there be phymosis some care is required to arrive at a right conclusion. The orifice of the prepuce is to be well cleaned by syringing or careful wiping, and then the surgeon should endeavour to expose the meatus urinarius, and at the same time press forwards along the urethra; if pus be seen to flow from the urethra there is *urethritis;* a history of an urethral discharge before the phymosis appeared, or of scalding pain in micturition along the urethra, or of chordee, supports this conclusion, and if the meatus cannot be exposed the diagnosis may be made from those symptoms alone. If the discharge be sanious and not thick creamy pus, *soft chancre* is to be diagnosed; the presence of chancres at the orifice of the prepuce, or the history of an ulcer before the phymosis, is strong corroboration.

When the swelling of the prepuce is not uniform and a distinct induration is felt at one part, and there are several indolent buboes in the groin, it is to be diagnosed as *primary syphilis;* should the patient show the signs of secondary syphilis, the diagnosis is at once certain; the discharge is watery in appearance. If there be a chronic progressive enlargement of the end of the penis in a man past middle life, discharging a bloody watery fluid, and a red granular or fungating growth is to be seen inside the prepuce, or even ulcerating or fungating through it, it will be recognised as *epithelioma*, especially if the inguinal glands are infiltrated. But a similar swelling with a thin discharge, in a young man, with a bright, florid, granular appearance of the growth, would be diagnosed as *warts.* (*See also* page 285.) When the discharge is purulent in character, and is found not to flow from the urethra, and there is no localised induration of the prepuce, it it is *balano-posthitis.* This may complicate urethritis, or arise from an impure connection, or be caused by congenital phymosis and the irritation of retained smegma or urine, or a preputial calculus. Where the inflamed prepuce can be drawn back the mucous surface is seen smeared with discharge, and presenting bright red excoriated patches without any induration or ulceration.

Ulcers on the penis.—The surgeon should first note the *age* of the patient; venereal sores are found in young children, and occasionally in elderly men, but they are most common in young men, while epithelioma is usually met with in those over forty-five. The *previous history* of the patient in reference to syphilis may afford great help; for if he have previously had syphilis it shows that an ulcer cannot be a primary syphilitic sore (exceptions to this are very rare), while it supports the diagnosis of gummy ulcer and relapsing ulceration of a hard chancre. A history of many similar attacks of short-lived ulceration of the prepuce supports the diagnosis of herpes. The relation of the ulcer to *sexual intercourse* must be inquired into. The date of the last, or of the supposed infecting intercourse, must be obtained, and the time when the symptoms were first afterwards noticed. Patients sometimes withhold the truth; and the information may be misleading, owing to infection occurring previous to the last intercourse, or illicit sexual connection may have been the means of drawing the patient's attention to a sore or growth previously present. *Soft chancre* has no incubation period, and the ulcer is noticed, or may be noticed if the patient is observant, two or three days after infection, while *hard chancre* has an incubation period of about three weeks. *Confrontation*, or an examination of the woman supposed to be the source of infection, when possible, may at once clear up the diagnosis, for in her the disease may be unmistakable. The surgeon should carefully observe or enquire into the *initial stage* of the ulcer, whether a crop of vesicles (herpes), a pustule (soft chancre), an induration (hard chancre), a softening induration (gumma), a crack or a wart (epithelioma). Where multiple sores can be seen in various stages of development they are certainly not primary syphilitic lesions, which, if multiple, are always exactly contemporaneous. The *number* of the ulcers is of some importance. Herpes and soft chancre are often multiple, the sores coming out one after another, or in successive crops, and at any one time may show various stages of development; hard chancre is almost invariably single, but if multiple all the sores are of the same age; gummy ulcers may be multiple, or appear successively; epithelioma is always single, but a single growth may ulcerate at more than one place. The *features of the sore* to be especially noted are ulceration and induration. *Ulceration* with distinct loss of substance, must be distinguished from mere abrasion of epithelium; its depth must be noted, and the character of the base, whether spongy, sloughy, or irregular and warty; undermining or eversion of the edge must not be overlooked. Ulceration is the essential feature of a soft chancre, which may be modified, but is never absent. Sloughing phagedæna, or a serpiginous character of the ulcer, are noteworthy facts. *Induration* must be closely studied to determine its extent, degree, definition, and vascularity. When very vascular, and therefore not readily blanched by pressure, and with an ill-defined outline which gradually fades off into the surrounding tissues, it is inflammatory; when the induration is firm, easily blanched when compressed, with a clear well-defined outline, smooth and flat, it is syphilitic; when chronic, irregular, or nodular and warty, hard and very vascular, it is probably epitheliomatous. Induration is the essential feature of a hard chancre, to which ulceration may be superadded. The induration may be of very slight depth, feeling like parchment or paper under the skin or mucous membrane; when the sore implicates the glans and its covering it may vary in degree in the two structures. The *discharge* from a soft sore is purulent, it may be sanious; that from a hard chancre is watery and only contains pus when inflamed. The *glands* in each groin should be felt, and if enlarged, the surgeon should notice the number, size, mobility or adhesion, consistence and sensitiveness of the affected glands. In hard chancre the glands, usually in both groins, are always enlarged within two weeks of induration of the sore; the buboes are multiple, hard, not matted together, freely movable over the fascia and under the skin, and not tender; suppuration is rare. In soft chancre the glands may escape altogether, the bubo is usually single, evidently inflammatory, painful, tender, of considerable size, and the gland is fixed to the skin and to the fascia; there is a marked tendency to suppuration. In epithelioma the glands undergo steady, painless, infiltrating enlargement, spreading from gland to gland.

The *effects of treatment.*—Where a venereal sore quickly yields to local non-specific treatment it shows that it is not syphilitic; the rápid healing of a deep ulcer under iodide of potassium shows it to be gummatous and neither cancer nor hard chancre; while the healing of a sore when the system is got under the influence of mercury points to its being a hard chancre. *Microscopical examination* of a scraping of a sore may prove it to be epithelioma. (*See* page 273.)

1. If the sore be quite superficial, not extending through the mucous lining of the prepuce, of recent origin, not indurated, and attended with much itching and smarting, it is probably *herpes preputialis;* and if the patient have suffered from similar attacks, and the affection be known to begin in a group or groups of tiny vesicles on a bright red base, this diagnosis is certain.

2. A linear crack at the orifice of the foreskin, noticed immediately after connection, which does not deepen or widen, and quickly heals up, is a *simple fissure;* this may be multiple and recurrent when there is a certain amount of phymosis; it is not unfrequently seen at the frænum when that band is tight.

3. If an acute ulcer develop at once after exposure to infection, wear a punched-out appearance, with sharply-cut edge, an excavated spongy base, without surrounding or subjacent induration, it is a *simple soft* or *non-infecting chancre.* This diagnosis is confirmed if the sore be known to have commenced as a pustule, if the ulcer be multiple, and fresh ulcers form from time to time where cracks or erosions are in contact with the abundant purulent discharge, and if there be inflammatory enlargement of an inguinal gland. Should it be known that the patient has had syphilis, and if the sore yield readily

to local treatment, the diagnosis is still further supported. Inoculation of the discharge from such a sore succeeds in the patient or on another person, producing first a pustule and then an ulcer.

4. Where an ulcer with characters as above has an ill-defined and very vascular and inelastic induration extending around it and gradually fading off into œdema, it is an *inflamed soft chancre.* Care must be taken to distinguish this from the induration of a syphilitic chancre. *Sloughing phagedæna*, and *serpiginous* ulceration may attack a soft chancre, but in many of such cases there is evidence of previous constitutional syphilis. All soft chancres leave depressed cicatrices.

5. If an ulcer have a smooth glistening base, a rounded sloping edge, thin watery discharge, and a sharply-defined, firm, elastic induration around it which blanches on gentle pressure, it is a *hard chancre.* If the sore consist of a raised, flat, well-defined, elastic induration, either with or without ulceration, it is probably a *hard chancre.* The clearly-defined not very vascular induration is the special mark of the *initial lesion of syphilis;* it may vary from a small papule, or thin paper-like plate in the deeper layer of the skin, to a wide, very dense mass, with extensive ulceration. The diagnosis will always be confirmed by noticing that the induration appeared from three to six weeks after infection, although there may have been a sore before, by the detection of multiple indolent buboes in both groins about the second week after the appearance of the induration, and by the appearance of the secondary eruptions and sore throat, etc. The sore is usually single, and does not leave a permanent scar.

6. If an ulcer have at first the characters of a soft sore and later on specific induration occur, it is a *mixed chancre,* and constitutional syphilis will follow. The

surgeon cannot assure a patient of his freedom from syphilis unless a period of at least six weeks from the date of exposure to infection have elapsed without the development of a specific induration; the occurrence of a soft chancre in no way protects against or renders unlikely the subsequent development of a hard chancre.

7. If in a patient known to have had syphilis an induration, or an indurated ulcer like a hard chancre, be found at the seat of the primary syphilitic lesion, without any lymphatic enlargement, it is a *recurrent chancre* or a recurrence of the chancrous process in the site of the original primary lesion.

8. If the ulcer be deeply excavated with undermined edge, and a tough or soft tenacious slough adhere to the base, and this have resulted from the softening down of a chronic induration of the penis in a man known by other signs to have syphilis, it is certainly a *gummatous ulcer*. There will not be glandular enlargement; the sore will yield to treatment and leave a depressed scar.

9. If the ulcer be chronic, and steadily progressive in spite of any treatment, with a warty irregular hard base, nodular everted edges, a foul watery or sanious discharge, and an infiltrating enlargement of one or more inguinal glands, it is *epithelioma*.

Gangrene of the penis may arise in the course of specific fevers, from paraphymosis, phymosis with concealed chancre, or from sloughing phagedæna.

Tumours of the penis may be grouped into the *superficial* and the *deep*. The surgeon should notice the mode of attachment or fixation of the tumour to the surrounding parts, and the history or signs of constitutional disease.

If the tumour be a sessile or pedunculated outgrowth from the skin or mucous membrane, with no surrounding induration, and a branched irregular surface, florid and moist where covered by the foreskin, dry and hard when exposed, it is a *papilloma* or *wart.* These little growths are generally multiple, they usually follow urethritis or balanitis; they may attain a large size, and then if exposed to friction they may ulcerate superficially. (*See* page 285.)

A flat sessile outgrowth of slight thickness and moderate induration, with a milk-white eroded surface, with other signs of syphilis, is a *mucous patch.*

If the tumour infiltrate the tissue of the penis as well as grow from its surface, having a firm irregular outline, a granular or warty surface, and the patient be at or past middle life, it is *epithelioma.* The growth usually quickly ulcerates and infects the inguinal glands. Cancer may grow out of sight under a tight prepuce, or by its bulk prevent retraction of the prepuce, and it may spread up along the deep structures of the penis.

If a firm or boggy induration be found in the prepuce or deep in the corpora cavernosa, and show a tendency to adhere to the skin and to soften down, it is a *gumma;* other evidence of syphilis and the effects of good treatment confirm the diagnosis.

Very chronic indurations, which do not soften down, are movable under the skin, and apparently situated in the sheath of the corpora cavernosa, are *gouty indurations;* at least they are not gummata, they occur quite independently of syphilis, and are often associated with gout. Indurations of the penis are also found lingering for many months after injury to the part; they are sometimes spoken of as *thrombosis.* The author has seen a case where inflammation spreading from the urethra led to intense and obstinate induration of the corpora cavernosa. All deep indurations of the penis cause chordee.

Scirrhus of the penis has been described; it will be recognised by its stony hardness, steady growth, and infection of the glands. The author has once amputated the organ for *melanosis*.

Cicatrices on the penis.—The initial lesion of syphilis does not leave a scar; soft chancre leaves a depressed scar which may after a time wear out; gummy ulcers leave depressed, thin, ill-nourished scars often having much pigment in them. A scar at the seat of a venereal ulcer is strong, but not conclusive, evidence that the sore leading to it was not syphilitic. The extensive scars of phagedæna and serpiginous ulceration are signs of syphilis, inasmuch as these processes are most common in the subjects of this dyscrasia.

CHAPTER XXXVIII.

DIAGNOSIS OF DISEASES OF THE FEMALE GENITAL ORGANS.

It will be sufficient to point out the diagnostic features of a few only of the common diseases of the female external genitals.

Vulvitis, *vaginitis*, and *urethritis* are recognised by the discharge from the inflamed surfaces, as well as by the swelling, redness, heat, and pain; often all three coexist. To determine the existence of urethritis, and the labia should be separated, and the meatus urinarius carefully wiped clean; the finger should then be passed into the vagina and pressed along the urethra, when a drop of pus may be seen at the meatus. The existence of urethritis is strong, but not positive, evidence of the inflammation being contagious, or gonorrhœal, in nature.

Labial abscess is recognised by the fluctuating swelling, with the ordinary signs of inflammation. When the swelling is mainly on the inner surface, and fluctuation is obtained there, it is due to *suppuration of Bartholine's gland.* Labial abscess may be chronic as well as acute.

A rapid sloughing of the vulva is sometimes seen in young children. It is called *noma vulvæ.*

Ulcers.—*Hard chancre* and *soft chancre* are common in this situation; for their diagnosis *see* page 496. Occasionally, numerous small punched-out superficial ulcers are found on the inner surface of the labia, the nymphæ, and on the clitoris, which result from the breaking down of small superficial nodules; it is a rare disease, known as *follicular vulvitis.* Chronic ulcers, with sloughy base and ragged edges, are due to late *syphilis;* they may, when very chronic, become indurated, but the history and signs of constitutional syphilis distinguish them from the "primary sore." A chronic ulcer, with irregular granular or fungating base, and indurated everted edges, steadily growing with enlargement of the inguinal glands, is *epithelioma.*

Mucous patches and erosions are common in the secondary stage of syphilis.

A deep red, painful and tender swelling at the meatus urinarius, attended with severe pain in micturition, is a *vascular papilloma;* this tumour is most common in women of middle and late life. Hypertrophy of the nymphæ, or great enlargement of the labia with pendulous solid outgrowths are not uncommonly observed; the latter especially in the subjects of syphilis.

CHAPTER XXXIX.

DIAGNOSIS OF DISEASES OF THE SCROTUM, TESTICLE, AND SPERMATIC CORD.

THE scrotal tissues are freely movable over the testicle and cord, and this fact enables us at once to distinguish diseases limited to them from affections of the scrotal contents.

A. **Diseases of the scrotum.**—The presence of superficial *varicose veins*, of *pendulous scrotum* from relaxation of the dartos, and of *hypospadias*, with vertical cleaving of the scrotum into two labium-like halves, each generally containing a normal testicle, is easily recognised. Want of development of the scrotum is associated with absence of the testicle from the scrotum, and may involve one or both sides.

Simple redness of the skin of the scrotum may be due to:

Intertrigo.
Eczema.
Erysipelas.
Syphilis.
Subjacent inflammation.
Blood-staining.

The surgeon should observe whether it is acute or chronic, a purely local affection, or attended by signs of constitutional disease such as fever, syphilis, gout, and whether there is any sufficient local cause for the erythema, such as dirt.

If it occur on the sides of the scrotum where it is in contact with the thigh, and be accompanied by a similar change in the skin of that region, the surface being constantly moist, it is *intertrigo*. This is most common in young children and in stout adults.

If the surface be moistened with a thin discharge which stiffens linen, and in places be covered with thin scaly crusts of dried discharge, it is *eczema*.

If the affection be acute, marked by a bright red colour of the skin, with œdema, a tendency to vesication, smarting or itching pain with marked tenderness, and be associated with severe constitutional disturbance and fever, it is *erysipelas.* (*See* page 68.)

Occurring in young children as a part of a coppery-red eruption, involving the nates as well as the scrotum, with flat papules, and perhaps moist mucous patches, it is a manifestation of *inherited syphilis.*

The skin is reddened in acute inflammation of the testicle or epididymis, the signs of which are very severe local pain and tenderness, and swelling. (*See* page 502.) The discoloration from *blood-staining* is readily recognised. (*See* page 26.)

Swelling of the scrotum.—The surgeon must notice whether the swelling pits on pressure (*œdema*), fluctuates (*abscess*), or is solid.

Œdema may be *local*, or part of *general* œdema from Bright's disease, morbus cordis, or obstruction to the inferior vena cava. *If local*, it is inflammatory or urinary; when the swelling is attended with redness, pain, heat and fever, and especially if it affect only a part of the scrotum, it is *inflammatory*, and may be erysipelas or a commencing abscess. If, however, the swelling be at first unaccompanied by these signs, and have come on suddenly during an effort to pass water after a rupture or wound of the urethra, retention from a tight stricture, or a sudden discharge of pus from the urethra, and little or no urine flowed from the meatus, and if the swelling be found to involve the anterior part of the perineum as well as the whole scrotum, it is *extravasation of urine.* The swelling will spread to the penis and up over the belly, but not on to the thighs or around the anus; patches of skin may become gangrenous; the pulse is rapid and weak, while the tongue is usually dry and brown.

If the swelling fluctuate, and there be redness of the skin, heat, pain and surrounding œdema, it is an *abscess.*

If the swelling fluctuate, be tense, globular in shape, adherent to the skin in the centre, freely movable over the deeper parts, chronic and quite free from all signs of inflammation, it is a *sebaceous cyst.*

If the scrotal tissues be greatly thickened, very firm, with large wart-like projections from the surface, and this condition of "solid œdema" be the sequel of successive attacks of superficial erythematous swelling, it is *elephantiasis.* The parts often assume an enormous size, and the penis and the thighs may be involved. It is most common in natives or residents in Barbadoes, India, and other tropical and malarial districts, but it may occur in persons who have never been out of England. The same condition of skin and subcutaneous tissue of the leg is known as *Barbadoes leg ;* there is a great tendency to ulceration.

A condition like elephantiasis scroti, but characterised by the presence of soft warty projections, which from time to time discharge a watery (lymph) or milky (chyle) fluid, is known as *lymph scrotum.* This is often associated with chyluria. (*See* page 544.)

Circumscribed solid tumours.—Flat dusky papules with fine desquamation of the surface, are often seen during the period of *secondary syphilis,* and if these papules have a moist surface with a milk-white appearance, they are known as *mucous patches,* there will be other signs of syphilis to corroborate the diagnosis.

If the papules be quite small, firm and red in colour and the skin around be pigmented and the seat of intolerable itching, the disease is *prurigo.*

A single chronic warty growth in or from the skin, over which a scab forms, which when removed exposes a red granular surface, is probably a *soot-wart* or *epithelioma.* If the wart infiltrate the skin, and be found to spread slowly and to deepen in spite of local treatment, and especially if an inguinal gland on the same side become enlarged, this diagnosis is established. This disease is most common in chimney sweepers, and in men past forty years of age.

If the tumour grow under the skin which is freely movable over it, and have a soft consistence and a lobulated surface, and the growth be slow and painless, it is a *lipoma*.

Ulcers of the scrotum should be examined in the same way as ulcers of the penis (*see* page 492); but special care should be taken to notice whether the ulcer is adherent to the testicle, or if it be a sinus leading into the testicle.

If the ulcer be acute, sharply cut with deep spongy base, red areola and purulent discharge, and if it were noticed a few days after an impure coitus, or if it have developed in succession to similar sores on the penis, it is a *soft chancre.*

If the ulcer take the form of a well-defined raised induration, with abraded or ulcerated surface, with a serous discharge, and there are indolent buboes in each groin, it is a *hard chancre.* (*See* page 496.)

If the ulcer be chronic, sinuous or serpiginous, with depressed smooth base, or be in the form of a deeper chasm with undermined edges and a tough yellow sloughy base, it is a late *syphilitic ulcer*.

If the ulcer be chronic, slowly but steadily advancing, with induration of the base and around the edge, and a warty surface, it is *epithelioma*.

Some ulcers are traumatic in origin or result from the separation of sloughs. *Sinuses* are either *urinary* or *tubercular;* in the one case urine flows from them, and in the other there is tubercular disease of the testicle or epididymis.

If the base of the ulcer be formed by the testicle which projects beyond the skin, it is known as *fungus* or *hernia testis.*

Fungus testis.—(1) If the base of the ulcer project but little and be formed of granulations of a pale pink colour, and the outline of the testicle be unaltered or moderately enlarged, it is a case of *superficial fungus* due to a growth of granulations from the tunica vaginalis and tunica albuginea.

(2) If the base of the ulcer be more prominent, of an ash-grey sloughy appearance, with a thin discharge in which spermatozoa are found under the microscope, the outline of the testicle being greatly altered from more or less of its structure being protruded through the scrotum, it is *syphilitic fungus*, due to softening and sloughing of a gumma of the testicle, with protrusion through an opening in the skin. There will be other evidence of syphilis.

(3) If the ulcer be on the outer side of the scrotum, with a pale grey base formed by a protrusion from the epididymis, the rest of which is enlarged and nodular, it is *strumous fungus.* The discharge is thin pus, with caseous or cretaceous flakes, and never contains spermatozoa. This form of fungus may be met with in connection with the body of the testicle.

(4) *Fungus testis* may follow the opening of any abscess in the testicle, and so may occur in the rare cases of acute orchitis which end in suppuration.

(5) If the testicle be *greatly* enlarged, with all the signs of malignant disease (*see* page 514), with an irregular mottled mass protruding from an ulcerated opening in the skin, with an abundant sero-sanious discharge, often attended with repeated hæmorrhages, it is *malignant fungus.* Whenever a malignant tumour fungates through the skin, and bleeds freely from time to time, it is known as *fungus hæmatodes.*

Gangrene of the scrotum is most commonly caused by extravasation of urine; it may result from phlegmonous erysipelas, frost-bite, or thrombosis after acute fevers. The author has seen a case of mortification of the entire scrotum of a little boy, which appeared to be analogous to noma vulvæ. (*See* page 500.)

B. **Diseases of the contents of the scrotum.**—The surgeon may find one or both of the *testicles absent or too small*, and if so, he has to distinguish between the congenital and the acquired forms of these affections.

A testicle is absent from the scrotum.—If the corresponding pouch of the scrotum be, and always have been, small, and no scar be visible in it, while there is no trace of testicle or cord to be felt there, it is a case of *undescended testicle.* The surgeon must seek the gland in the inguinal canal, the iliac fossa, or the perineum. (*See* page 531.) If, however, a linear cicatrix be seen in the scrotum, and the testicle cannot be found elsewhere, it is a case of *castration.*

A testicle is too small.—This may be due to imperfect development, or to wasting of the organ. The surgeon should notice whether the whole testicle is absent, the vas deferens being entire, or the body of the testicle alone is absent, or the body small; and, further, he should notice any scars in the scrotum or adhesion of the organ to the skin. Entire absence of a part is a congenital deformity; in wasting of the organ its remnant is always to be detected. A small size of the left testicle is not uncommon in association with varicocele, and is to be distinguished from wasting of the organ, by the absence of softening, or of nodular induration. The known causes of wasting of the testicle (affecting the body only) are acute inflammation, particularly in association with parotitis or injury, injury to the back of the head or spine, strumous disease of the same or of the opposite testicle, and aortic aneurism blocking the orifice of the spermatic artery. The author has had under his care a man with advanced strumous disease of the left testicle, in whom the right organ has been observed to waste away to a small pea-like appendage of the epididymis.

The cases that present difficulty in diagnosis are those of enlargement of the scrotal contents. The surgeon should commence his examination by grasping the root of the affected side of the scrotum between fingers and thumb, which will enable him to distinguish between tumours entirely in the scrotum and those which reach up into the inguinal canal. Many scrotal tumours are associated with swelling of the spermatic cord, but a little experience will enable the surgeon to distinguish this from an extension of the actual tumour into the groin. Only scrotal tumours will be considered in this chapter; inguino-scrotal tumours are discussed in chapter xl.

DIAGNOSIS OF INTRASCROTAL TUMOURS.

The surgeon should first feel whether there is an expansile impulse in the swelling during coughing, or in children during crying or straining (*see* pages 271-2); then try whether the swelling is reducible into the belly (*see* page 269 *et seq.*), translucent or opaque (*see* pages 261-2), and then he should enquire into the history of the origin and course of the swelling. The next step is to trace out accurately the relation of the swelling to the body of the testicle and the epididymis; and it must be borne in mind that this organ may be so rotated that the epididymis is anterior to the body, or, more rarely, on the outer or inner side. In the following descriptions the body of the testicle will be spoken of as the "testis," in contradistinction to the "epididymis," and the entire organ will be called the "testicle.'

I.—The tumour gives an expansile impulse.

Congenital hydrocele.
Varicocele.

Examine for translucency.

If the swelling be translucent and fluctuating it is a *congenital hydrocele.* These tumours are rounded and even, usually distending the scrotum and completely surrounding the testicle (*vaginal*) ; they may be limited to the cord (*funicular*).

If the tumour be opaque, with a soft knotty feel, it is a *varicocele.* This affection is usually limited to the left side, it is very common in young men, and may attain a large size, reaching down to or even below the testicle, but never all round it. It is easily reduced into the belly by placing the man on his back and then raising the scrotum ; if now the surgeon place his finger gently over the external abdominal ring and allow the man to rise, the swelling will gradually reappear in the scrotum from below up, without giving the surgeon the sensation of anything slipping past his finger. This sign is pathognomonic of varicocele.

II.—**There is no impulse on coughing.** —Examine for fluctuation, and then for translucency.

III.—**The tumour fluctuates and is translucent.**

Acute hydrocele.
Chronic vaginal hydrocele.
Encysted hydrocele.

(1) If the swelling have formed rapidly, existed but a short time, be painful and very tender, and covered by reddened skin, it is *acute hydrocele.* This is but an accompaniment of acute epididymitis, and is only rarely so marked as to be recognised distinctly. There are the usual signs of epididymitis. (*See* page 511.)

(2) If the swelling be chronic and surround the testicle completely, that organ being found at the bottom of the tumour and usually at the back, it is a *chronic vaginal hydrocele.* This tumour is painless except from its weight, and fluctuates distinctly. It is

most frequent in men at and past middle life, but not uncommon in young children.

In all cases of vaginal hydrocele it is essential to *determine the position of the testicle in the sac.* If the parts were previously normal, the testicle will be at the back and lower part of the sac. But if the testicle be inverted, it will be in front and at the lower part; and as there will be nothing in the history of the case or in the condition of the other testicle to indicate this, it must be determined by examination. There are *three means of determining the position of the testicle in a hydrocele:*

(*a*) *It is more resistant* to pressure than is the fluid.

(*b*) *It is tender* to pressure, the patient experiencing a sickening sensation when the testicle is compressed.

(*c*) *It is opaque.* When determining the translucency of a hydrocele always search for the opaque testicle. (For characters of fluid, *see* page 517.)

(3) If the swelling do not surround the testicle or take the form of the tunica vaginalis, it is an *encysted hydrocele.* The surgeon can determine by palpation whether it is connected with the *testicle* or the *cord.* If the former he should feel whether the base or pedicle of the tumour is fixed to or rests upon the epididymis or the testis. These cysts are common, especially in young men, are often of small size and stationary for years, or they may be large and multiple, or associated with vaginal hydrocele. Their outline is usually globular.

IV.—**The tumour fluctuates and is not translucent.**

Hydrocele
Hæmatocele.

Abscess.

If the *tumour have appeared suddenly* after an operation, accident, or strain, it is a *hæmatocele.* Or if a chronic tumour have suddenly become larger and very tense after an accident or strain, it is a *hydro-hæmatocele*, or a hydrocele into which blood has become effused. *Hæmatocele* is a rare affection, often associated with an extensive subcutaneous extravasation of blood. As fibrin coagulates on the interior of the sac the tumour becomes firm and fluctuation is obscure. If tapped, coffee-coloured fluid is withdrawn, and the tumour partially or wholly disappears. The tumour is heavy, generally ovoid in shape; the testicle when normally placed is at the lower and back part of the swelling. *Hydro-hæmatocele* may be vaginal or encysted, the distinctions between which are the same as those between vaginal and encysted hydrocele, *q.v.*

If the tumour have gradually increased, with signs and symptoms of inflammation, it is an *abscess.* The pus may be visibly pointing most often at the bottom of the scrotum. Abscess may be the termination of hæmatocele, or of strumous disease of the testicle.

If, after the disappearance of the blood from the tunica vaginalis, the testicle be found enlarged, hard, and tender, it is probably the seat of *parenchymatous hæmatocele*, and if, an incision having been made into the tunica vaginalis, the testicle protrude at the opening, and ultimately the tunica albuginea give way and a dark brown or black fungus protrude from it, this diagnosis is established; the fungus in such a case is composed of seminal tubules and blood clot.

If the swelling be chronic, fluctuating throughout, of the usual shape of the distended tunica vaginalis, and there be an absence of all history of injury, strain, or sudden appearance, it is a case of *opaque hydrocele.*

Solid tumours must be grouped into acute and chronic; the position and shape of the swelling, and, in acute disease, the position of chief pain and tenderness, will determine whether the testis, epididymis, or both, are involved. In chronic disease special attention should be paid to the consistence, outline, and sensitiveness of the swelling, its adhesion to the scrotum, the affection of one or both testicles, thickening of the cord, and the association with enlargement of the inguinal, iliac, or lumbar glands. The surgeon should investigate the condition of the urethra for urethritis, stricture, calculus, and enquire for a history of urethral instrumentation and signs of tubercle, struma, or syphilis in other parts. The vesiculæ seminales should be examined from the rectum.

V. The tumour is solid and acute.—

Acute epididymitis.	Acute orchitis.

Acute epididymitis is much the more frequent. Acute inflammation causes swelling, tension, hardness, pain and acute tenderness of the part affected. Examine the organ carefully to determine what part is swelled or indurated or most tender. If the swelling be elongated and at the back of the organ and the body of the testicle be felt of its usual size and consistence at the upper and anterior part of the swelling, it is *acute epididymitis.* If the swelling be globular in outline and the induration and tenderness be most marked in front and at the sides, it is *acute orchitis.* It must be remembered that with inversion of the testicle, acute epididymitis causes an elongated indurated swelling in front, and the body of the organ is felt at the back. Inflammation may spread from the epididymis to the testis proper. The pain and tenderness are more severe in acute orchitis. The coverings of the scrotum are red, swelled, and the veins full. The spermatic cord is enlarged and tender. The history of gonorrhœa, stricture, catheterism or of an impacted calculus or of some operation upon the prostatic urethra aids the diagnosis of epididymitis. The history of parotitis supports the diagnosis of orchitis.

VI. Chronic solid tumours of the epididymis.

Simple chronic epididymitis.
Strumous epididymitis.
Syphilitic epididymitis.

If the disease began acutely, and the pain, the redness of the scrotum, the fulness of the cord and in part the swelling of the organ have subsided; and especially if the man were the subject of gonorrhœa, gleet, or stricture of the urethra when the disease commenced, it is *simple epididymitis.* The enlargement is always hard; it may implicate the *globus minor* only, or the whole of the epididymis.

If the disease have been chronic from the first, slowly advancing, commencing in one testicle, and only after a time, if at all, affecting the other, nodular, varying in consistence from firm or elastic to fluctuating, slightly tender with fulness or nodular thickening of the cord, it is *strumous epididymitis.* This is confirmed if a nodular growth like that in the epididymis be found in the cord or if the vesicula seminalis of the same side or the prostate be found to be enlarged, or if there be evidence of tubercular disease of the bladder, kidneys, lungs, or other organ. Strumous epididymitis may commence very insidiously, or in an attack of gonorrhœal epididymitis or there may be a history of an injury. Before suppuration occurs, adhesions of the epididymis to the scrotum form; these are most common at the globus minor. Strumous epididymitis may be associated with hydrocele or hernia testis.

If the disease affect the globus major first and alone, or more markedly than the rest of the epididymis, causing a hard smooth swelling, varying in size from a pea to a walnut, painless or nearly so, and this occur during the first twelve months after syphilitic infection, it is *syphilitic epididymitis.* This disease is often bilateral, and it is very rarely accompanied by any affection of the body of the testicle. *Gumma of the epididymis* is occasionally met with, nearly always in association with gumma of the testicle.

VII. **Chronic solid tumours of the testis only.**

Chronic orchitis.
Tumour of the testicle.

It is sometimes impossible to distinguish between these two affections without watching the case to note the course and progress of the disease and the effect of mercurial treatment. Chronic orchitis can generally be recognised by the origin of the disease, or by the detection of the syphilitic diathesis.

A uniform firm enlargement of the testicle, arising insidiously or from a blow, or in association with constitutional syphilis, gout, malaria or disease of the urethra or prostate, especially if painful and slightly tender, first affecting one testicle and then the other, with slight or no thickening of the cord, and no enlargement of inguinal, iliac, or lumbar glands, is *chronic orchitis*. Of this there are several varieties.

If the testicle be only moderately enlarged, the whole testis being indurated (often it is of stony hardness) smooth on the surface, very slightly, if at all, tender, with loss of "testicular sense," no pain except a sense of dragging in the groin and loin from the weight of the organ, and the cord be not enlarged or merely full; and if this be found affecting both testicles in a young or middle-aged man the subject of syphilis, most often two or three years after infection, or a young child the subject of inherited syphilis, the disease is *interstitial syphilitic sarcocele*. There is often a small amount of hydrocele associated with and partly concealing the testicle.

If the enlargement be distinctly nodular and the enlargement greater, although perhaps affecting only a part of the testicle, and especially if the scrotum be adherent to the testicle at any part or there be a fungous protrusion of the testicle through an ulcer in the scrotum (*see* page 505), or there be a sinus leading down to the enlarged testicle which may be seen to be yellowish-grey in colour, tough and sloughy; and if this be met with in a man suffering from tertiary syphilis, several years after infection, it is a case of *gummatous sarcocele.*

If the enlarged testicle be painful and tender, less hard than in syphilis and associated with dyspepsia, cramps in the calf of the leg, pain in the heel, and an acid loaded state of the urine, it is to be regarded as *gouty orchitis.*

A similar uniform enlargement coming on insidiously with moderate pain and tenderness, and some fulness of the cord, may be met with in men who have long resided in malarious districts, and is regarded as *malarial orchitis.*

Malignant tumour of the testicle is to be recognised by some or all of the following signs: generally an insidious origin, very rapid growth or gradual progressive enlargement in spite of treatment, great size of the tumour, and heaviness, difference in consistence in different parts, early loss of "testicular sense," dilatation of scrotal veins, adhesion of the scrotum, fungus (*see* page 505), enlargement of the cord (uniform or nodular) and secondary enlargement of the lymphatic glands in the groin, iliac fossa, and along the lumbar spine; in some cases there is well-marked cachexia. These tumours occur most often in children and in men after thirty-five years of age. If there be vaginal hydrocele there may be fluctuation over the front of the tumour. The malignant tumours vary much in their rate of growth, and their signs differ at successive periods of development. The first sign is a uniform firm enlargement of the testicle, which later on becomes softer in places; then follow enlargement and implication of the cord (in some cases), glandular enlargement, and later still (in some cases) adhesion of the scrotum and malignant fungus. (*See* page 505.)

(1) All malignant tumours occurring before puberty are *sarcomata.*

(2) All malignant tumours affecting both testicles are *sarcomata.*

(3) A preliminary period of quiescence or of slow growth in the tumour, with a sudden accession of activity and very rapid growth, is in favour of the tumour being a *chondro-sarcoma.*

(4) Uniform rapid growth of the tumour, with early and marked implication of the spermatic cord, is a frequent sign of *carcinoma.*

(5) A very gradual enlargement of the testicle, especially if soft spots can be felt on the surface, and if when the tumour is tapped a mucoid fluid mixed with blood (*see* page 518) is withdrawn, indicates that the tumour is largely *cystic* in nature. Although cystic disease of the testicle is generally *cystic sarcoma* and therefore malignant, other examples are to be classed rather as *cystic fibroma.* This distinction can only be proved by careful microscopic examination; but the slower the rate of growth of the tumour, the less the probability of its being sarcomatous. Cysts are met with also as the result of degenerative changes in sarcoma and carcinoma.

(6) If the testicle be plainly perceptible to touch, and by the patient's "testicular sense" at the back of the mass in the scrotum, the tumour is *malignant disease of the tunica vaginalis*, a very rare affection.

(7) A very gradual enlargement of the testicle with bossy or tuberous surface, incompressible, heavy, without affection of the cord or glands, or adhesion to the scrotum, is probably an *enchondroma.*

If tumour of the testicle, of insidious origin, have grown extremely slowly, and be firm, nodular, and painless, without affection of the cord, lymphatic glands, or scrotal coverings, and occur in a patient free from syphilis, gout, malaria, or urethral disease, it may be diagnosed as a *benign tumour of the testicle.* These are very rare. They may be *fibroma*, *myoma*, or *fibro-myoma*, and some would also include amongst benign tumours of the testicle, *enchondroma.*

If a congenital tumour be found to spring from or close to the testicle, and be of globular outline and varying consistence, being in places fluctuating and at others solid, it is probably a *dermoid cyst.* These tumours may remain small or grow to an enormous bulk or suppurate, etc. Cysts containing *guinea-worms* and *acephalocysts* have been met with in the scrotum. They cannot be diagnosed.

VIII. **Chronic solid tumours of the testicle.**

Strumous orchitis.
Syphilitic orchitis.

Secondary orchitis.

If the disease began in the epididymis, which is found nodular, enlarged and with the characters of *strumous epididymitis* (*see* page 512), the body of the testicle being affected less and later, this affection consisting of an irregular enlargement, it is a case of *strumous orchitis*, in which the disease has advanced from the epididymis to the body of the gland. This disease may be complicated with *hydrocele*, *suppuration*, *fungus testis*, or *sinus.*

If the body of the testicle be enlarged and indurated, with the characters mentioned as distinctive of *syphilitic sarcocele* (page 513), and in addition there be a hard nodular projection at the back and outer side of the gland, it is from the disease having spread to the epididymis, and it may be called *syphilitic orchitis.*

This is a rare condition. It may be complicated with *hydrocele* or *fungus testis.*

A chronic enlargement of the testicle, in which the epididymis is not to be distinguished, tender and distinctly painful, with thickening of the cord, may be met with in connection with stricture of the urethra, prostatic enlargement or prostatic calculus, and is to be recognised as *secondary orchitis.* In these cases the disease has spread from the epididymis to the body of the testicle.

Diagnostic value of puncture of scrotal tumours.—In some instances it is impossible to determine the nature of a swelling, without resort to an exploratory puncture. The cases in which this would be employed are chronic tumours without obvious signs of inflammation, and they particularly include cases of hydrocele with thickened walls, hæmatocele, malignant disease, hydro-sarcocele and fibro-cystic disease.

Exploratory puncture is employed for three purposes:

First. To ascertain the *character of the fluid* withdrawn. (*See* page 274.)

(1) If the fluid be straw-coloured or greenish, slightly viscid and richly albuminous, it is from a *vaginal hydrocele.* This may be altered by the admixture of blood, of cholesterine crystals, or of fat. It contains a large amount of albumen (6 per cent.).

(2) If the fluid be colourless and watery, containing only a trace of albumen, it is from an *encysted hydrocele* of the testicle, epididymis, or cord.

(3) If the fluid have a more or less milky appearance it is from the admixture of semen (seminal cyst), and spermatozoa will be found by a microscopic examination. The addition of acetic acid causes effervescence but no turbidity or precipitate. In cases where an encysted hydrocele of the testicle

has ruptured into a vaginal hydrocele, spermatozoa may be found in the deposit from the straw-coloured fluid characteristic of the latter.

(4) If the fluid be mucoid, mixed probably with some blood, it is from one or more of the cavities of a "cystic testicle." The addition of acetic acid causes turbidity from the presence of mucin.

(5) If only pure bright red blood be withdrawn it comes from a solid tumour of the testicle. The rapidity of escape will show the degree of the vascularity of the tumour.

(6) If the fluid be altered blood, thicker in consistence and darker in colour, it is an old exudation (a hæmatocele).

(7) Dark amber-coloured fluid is probably the contents of a hydrocele of a hernial sac. (*See* page 521.)

Second. To ascertain the *effect of the tapping upon the* bulk and consistence of the *tumour.*

(1) If the bulk and consistence be diminished, the fluid has been withdrawn from a closed cavity as in hydrocele, hæmatocele and abscess. In a case of cystoma the quantity of fluid withdrawn from any of the cysts may be too small to render the change in the bulk of the tumour evident.

(2) If the bulk and consistence be not diminished the fluid has been withdrawn direct from the blood-vessels. In cases of congenital hydrocele and ascites, many pints of fluid may be drawn off through a scrotal puncture, and it will not be until the tension of the fluid in the belly is considerably diminished that the tension of the scrotal swelling will be materially lessened. The quantity of fluid withdrawn establishes the diagnosis.

Third. To permit of *a proper examination of the solid parts of the tumour.* In cases of syphilitic or strumous sarcocele with much effusion into the tunica vaginalis, it is impossible to examine the testicle until this fluid has been drawn off. In cases, too, of malignant disease of the testis there may be a considerable amount of secondary hydrocele, giving rise to fluctuation over the front of the tumour and concealing the surface of the growth. In cases of dermoid cyst a fine probe passed through the canula may strike upon teeth or bone.

The testicle is painful, without any alteration in its bulk.

If the testicle be simply abnormally sensitive, the slighest contact causing pain, the condition is known as *irritable testicle.* This is not unfrequent at puberty, and is also met with later in life as the result of masturbation; sexual excess, strong ungratified sexual desire, and debility, and in connection with hypochondriasis, varicocele, and gonorrhœa.

If the testicle be the seat of paroxysms of pain, dull, or intensely acute, of darting character usually passing up to the groin and loin or in the reverse direction, the condition is *neuralgia of the testicle.* In all such cases examine carefully for pyelitis, a renal calculus, renal colic, malaria, injury to the spermatic cord, disease of the lumbar spine or an abdominal tumour pressing upon the genito-crural nerve.

CHAPTER XL.

DIAGNOSIS OF INGUINO-SCROTAL TUMOURS.

If, on grasping the root of the scrotum, part of a scrotal swelling be felt between the fingers and the thumb, or if, the tumour being entirely in the scrotum, it can be pushed up into the groin apart from the testicle, it may be distinguished as *inguino-scrotal.*

VI. **Chronic**
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patient to cough the tumour will fill out again with a distinct expansile impulse. The flow of fluid along the narrow tube communicating with the peritoneal cavity may be attended with a vibratory thrill. If, on the other hand, the tumour be *suddenly* reduced by pressure, suspect *hydrocele of a hernial sac with a reducible hernia at the neck.* This diagnosis will be confirmed by the history of an old inguinal hernia with a recent considerable increase in the bulk of the tumour, and it will be established if, on reducing the swelling and placing the finger gently on the hernial ring and getting the patient to stand up, a translucent fluctuating tumour appear, while on gently raising the finger a further mass of intestine or omentum is felt to descend from the belly.

The tumour being found to be quite *irreducible by taxis*, enquire carefully into its history. If there be a history of a hernia on the same side, for which a truss has been worn, and the swelling conceal the spermatic cord, reaching quite up to the internal abdominal ring, and especially if at its upper end a firmer part be felt, the diagnosis of *hydrocele into a hernial sac*, with closure of the neck of the sac by adhesions or by an irreducible knuckle of intestine or piece of omentum, must be made. Such a tumour may have a slight impulse on coughing owing to the compression of the part in the inguinal canal. The combination of a small *strangulated hernia*, with considerable effusion into the sac, must be remembered. The ordinary signs of strangulation will be present and should lead to a correct diagnosis.

If there be no history of hernia and if the tumour be globular or ovoid in shape, tense, smooth in outline, without impulse on coughing, freely movable on the cord which it does not conceal, and separate from the testicle, it is an *encysted hydrocele of the cord.* Such cysts may be situated in the inguinal canal, and

If the swelling appeared suddenly at the groin, and extended into the scrotum, and it be inseparably fixed to the deep parts of the belly wall, and have a smooth rounded outline, through which coils of intestine or masses of omentum may be felt, it is a *hernia*. For fuller details of the diagnosis of hernial tumours *see* chapter xxxv.

Having excluded hernia, the surgeon should determine whether the swelling is solid or fluid by feeling for fluctuation, and it is often convenient to grasp the tumour in both hands, and then, while gently compressing with one hand, notice whether the fingers and thumb of the other hand are opened out.

If the tumour be fluid, test for translucency, and remember that a collection of serous fluid may fail to appear translucent owing to difficulty in applying the test in the groin or to the thickness of its coverings. Then notice whether the tumour is reducible or irreducible, and the surgeon must not mistake for reducibility mere mobility of the swelling in the inguinal canal; when a tumour is reduced the inguinal canal should be empty; if reducible, feel carefully for a pelvic or abdominal swelling, into which the fluid may have been forced. Similarly examine the effect of coughing, and distinguish between a true impulse filling out or expanding the swelling and a thrust downwards of the tumour; the spermatic cord moves slightly with a cough.

A. **Fluid tumours.**

Hydrocele { congenital.
encysted.
of hernial sac.
Hæmatocele, encysted.
Abscess.

Gently and continuously compress the tumour, and if it disappear or be reducible into the belly, it is a *congenital hydrocele of the cord.* On getting the patient to cough the tumour will fill out again with a distinct expansile impulse. The flow of fluid along the narrow tube communicating with the peritoneal cavity may be attended with a vibratory thrill. If, on the other hand, the tumour be *suddenly* reduced by pressure, suspect *hydrocele of a hernial sac with a reducible hernia at the neck.* This diagnosis will be confirmed by the history of an old inguinal hernia with a recent considerable increase in the bulk of the tumour, and it will be established if, on reducing the swelling and placing the finger gently on the hernial ring and getting the patient to stand up, a translucent fluctuating tumour appear, while on gently raising the finger a further mass of intestine or omentum is felt to descend from the belly.

The tumour being found to be quite *irreducible by taxis*, enquire carefully into its history. If there be a history of a hernia on the same side, for which a truss has been worn, and the swelling conceal the spermatic cord, reaching quite up to the internal abdominal ring, and especially if at its upper end a firmer part be felt, the diagnosis of *hydrocele into a hernial sac*, with closure of the neck of the sac by adhesions or by an irreducible knuckle of intestine or piece of omentum, must be made. Such a tumour may have a slight impulse on coughing owing to the compression of the part in the inguinal canal. The combination of a small *strangulated hernia*, with considerable effusion into the sac, must be remembered. The ordinary signs of strangulation will be present and should lead to a correct diagnosis.

If there be no history of hernia and if the tumour be globular or ovoid in shape, tense, smooth in outline, without impulse on coughing, freely movable on the cord which it does not conceal, and separate from the testicle, it is an *encysted hydrocele of the cord.* Such cysts may be situated in the inguinal canal, and then are forced downwards on coughing, but the *impulse is not expansile;* more often they are placed between the external abdominal ring and the testicle. In rare cases there is a narrow neck-like prolongation to be traced a short distance up the cord above the cyst; when the tumour is compressed this prolongation fills out, and *vice versâ.* Furneaux Jordon has called this variety *water-bottle hydrocele.*

If as a result of injury or strain an encysted hydrocele have become larger, more tense, painful and tender, and if it be found opaque and indistinctly fluctuating, an *encysted hæmatocele of the cord* may be diagnosed.

If the swelling of the cord be fluctuating, opaque, without impulse on coughing, immovable, irreducible, painful, tender, with the skin over it bulging, reddened and perhaps œdematous, the part being hot to the touch and the general temperature raised, and the internal abdominal ring be free, the diagnosis of *acute abscess of the cord* should be made.

If the swelling be elongated, rounded and smooth on the surface, opaque, fluctuating with a distinct expansile impulse on coughing, reducible into the belly through the inguinal canal but without any gurgle, it is a *pelvic or abdominal abscess* which has escaped along the spermatic cord. The abdominal or pelvic part of the abscess will be felt as a rounded, tense, fluctuating swelling with a distinct wave of fluctuation passing between it and the inguino-scrotal swelling. The abscesses which may thus make their exit are, psoas abscess, suppuration in connection with disease of the acetabulum, suppuration of the cellular tissue in front of the bladder, and abscess of the vesicula seminalis spreading up along the vas deferens to the abdominal ring. In the female, abscess may spread from the pelvis along the round ligament. For the diagnosis of these various forms of abscess, *see* page 528.

B. Solid tumours.

Inflammation of the cord.
Diffuse hydrocele of the cord.
Diffuse hæmatocele of the cord.
Lipoma of the cord.
Malignant tumour of the cord.

(1) If the *onset of the swelling have been acute* it is *inflammation* or *hæmatocele*.—If the swelling have come on independently of injury or strain, but in connection with urethritis, and the swelling be along the whole length of the cord, very painful, tender and firm, it is *acute inflammation of the spermatic cord*, which quickly spreads to the epididymis, and is rarely seen as an independent affection.

If the swelling appeared suddenly after an injury or strain and was associated with superficial ecchymosis, be irreducible, without impulse on coughing, stationary in size, or gradually or intermittently enlarging, it is *diffused hæmatocele of the cord.*

(2) *The onset of the tumour has been slow and gradual.*—If the tumour be of very slow growth or stationary, lobulated, freely movable under the skin and over the testicles, but loosely fixed to the cord, and if the tumour be irreducible, without impulse on coughing, opaque, and do not extend up to the internal abdominal ring, it is a *lipoma of the cord.*

If the tumour progressively and rapidly enlarge upwards along the cord, attaining a great size, becoming fixed to the surrounding tissues, and at length to the skin over it, and be attended with enlargement of the iliac and lumbar glands, it is a *malignant tumour of the cord* (*sarcoma* or *carcinoma*).

If the tumour be of small size, elongated, with a rounded contour, soft, pitting slightly upon pressure, it is œdema or *diffused hydrocele of the cord.* The swelling may have an impulse on coughing if it extend up to the internal abdominal ring, or may fluctuate at its lower part; it is particularly seen after wearing a truss.

CHAPTER XLI.

DIAGNOSIS OF DISEASES OF THE GROIN.

A. **The affections of the skin.**—*Intertrigo* is common in the fold of the groin of fat corpulent people; for its diagnosis, *see* page 501. *Mucous patches* (*see* page 475) may be met with.

B. **Ulcers of the groin.**—The ulcers met with are the primary, glandular, and late venereal ulcers, and those formed by the breaking down of epithelial or other cancerous growths in the inguinal glands.

If the ulcer be acute, with a depressed spongy base, sharply cut, irregular, worm-eaten or undermined edge, with abundant purulent discharge which irritates the skin around and produces similar ulcers when inoculated, it is a *soft chancre.* The diagnosis is confirmed by finding similar chancres on the genitals or elsewhere, or enlargement of the inguinal glands.

If the ulcer be deep and uneven, with a soft spongy base, livid red greatly undermined edge, profuse purulent discharge which is inoculable and irritates the skin with which it is in contact, and if the patient have at the time a chancre on the genitals, or a recent cicatrix left by one, it is an ulcer due to the formation and opening of a *virulent bubo.*

If the ulcer be covered with a black or white slough adherent to the base, and rapidly extend in area and depth, with formation of new sloughs at first white and then black, with profuse sero-purulent discharge, livid red swelling of the skin around, great pain, and severe constitutional disturbance (rapid weak pulse, anorexia, thirst, dry brown tongue, and pyrexia) it is a *sloughing phagedænic chancre.* This may be a complication of a simple chancre, or of a virulent bubo.

If the ulcer spread slowly, advancing by one (often undermined) edge, healing at the other, and in this manner affect wide areas of tissue, leaving behind it as it travels a firm adherent white scar, mottled with brown patches, it is a *serpiginous ulcer.*

If the ulcer be chronic, steadily progressing, with a very irregular base, being at places deeply excavated, at places nodular or fungating, with profuse fœtid watery or sanious discharge, and the surrounding tissues be infiltrated and thickened or form a considerable tumour, it is a *malignant ulcer.* This may be a primary growth in the groin, or a secondary glandular infection subsequent to malignant disease of the genitals or of the lower limb. The surgeon should examine for enlargement of the iliac and lumbar glands.

C. **Sinus in the groin.**—The *discharge* should be examined for fæcal matter and urine; a probe should be passed to determine the *depth* and *direction* of the sinus; the *neighbouring parts,* especially the spine, pelvis, genitals, and hip joint should be examined.

Sinuses may be divided into *superficial* (those not under the deep fascia) and *deep* (those running through the deep fascia).

The sinus is superficial.—If the sinus be covered with thin livid skin, unattended with much induration, and follow upon an acute abscess associated with gonorrhœa, chancre, an irritable sore on the heel or foot, or a strain, it is a sequel to a simple *bubo.*

If the sinus be irregular, multiple, running in a mass of indurated glands in which the individual glands are not to be distinguished; and if it be the sequel to a slow, painless enlargement of these glands with very chronic suppuration, the disease is known as *scrofulous bubo.* (*See* page 528.)

Artificial anus is recognised by the fæcal discharge, and by the continuity of the mucous membrane with the skin. (*See* pages 162, 454.)

The sinus is deep.

Fæcal fistula.
Urinary fistula.
Dermoid cyst.
Morbus coxæ.
Necrosis of pelvis or femur.
Pericæcal abscess.
Iliac abscess.
Psoas abscess.

If the discharge contain fæcal matter and flatus, it is a *fæcal fistula.* This may follow upon strangulated hernia, or on the right side upon a pericæcal abscess with perforation of the cæcum.

If the discharge contain urine, proved by the detection of urea (*see* page 161), it is an *urinary fistula.* The communication may be with the *bladder,* in which case the probe will pass over the brim of the pelvis; but the fistula more often communicates with the *urethra,* in which case there will be other urinary fistulæ in the perineum, and the probe will pass downwards and inwards outside the pelvis to the perineum. The escape of hair, teeth, fœtal bone or masses of fatty matter and epithelial débris, would show it to be a sinus in connection with a *dermoid cyst.*

If the probe pass towards the acetabulum or along the inner surface of the pelvis and there be evidence of *hip disease* (*see* page 365) there will be no difficulty in associating the sinus with the joint disease.

If the sinus pass down into the pelvis of a woman, and a vaginal examination show considerable induration around the uterus, and especially if the illness followed upon parturition or miscarriage or gonorrhœa, it is a sinus left from a *pelvic abscess.*

If the probe strike bare bone, the diagnosis of *necrosis* will be established, and the surgeon must then determine, by the direction and length of the sinus, where the sequestrum is; if it be the femur, the sequestrum will move when that bone is moved at the hip joint.

If the sinus open above Poupart's ligament, or below that ligament outside the line of the femoral artery, and extend upwards into the iliac fossa, it is the sequel of an *iliac abscess*; and if on the right side, and the pus be fœtid, and there be a history of constipation and bowel trouble preceding the abscess, the diagnosis of *pericæcal abscess* may be made. Failing that, and failing to find necrosis of bone and disease of the spine or sacro-iliac joint, the diagnosis of *simple iliac abscess* must be made. (*See* page 529.)

If the sinus open below Poupart's ligament internal to the femoral vessels, and run up into the belly, it is a sinus left by the opening of a *psoas abscess*. (*See* page 528.)

D. **Tumours of the groin.**—*The tumour is fluid.*

Abscess.
Cystic tumour.
Varix.

Aneurism.
Hydrocele of hernial sac.

If the swelling be accompanied with obvious signs of inflammation, either local or in some adjacent part, as the spine, the pelvis or the hip joint, or if the outline of the collection of fluid correspond with the sheath of a muscle, it is an *abscess*. (For further distinctions between chronic abscess and cyst *see* page 295.) The abscess may be acute or chronic. When superficial to the deep fascia, and forming a prominent swelling in the groin, covered with more or less acutely inflamed skin, it is a *bubo*, which may be in connection with the inguinal or the femoral glands, and arise in consequence of a sore on the foot or leg, gonorrhœa, balano-posthitis, or soft chancre; when, in connection with a soft chancre, a gland becomes acutely inflamed and rapidly runs on to suppuration, and on being opened itself shows all the features of a chancre, it is a *virulent bubo.* Where the inflammation is less intense and the pus forms around the gland, it is a *sympathetic bubo;* and when the abscess is more chronic still, fluctuation appearing at several places in a large ill-defined boggy swelling, it is a *scrofulous bubo.* (*See* page 532.)

The deep abscesses are either *femoral* or *pelvic,* and the diagnosis is readily made by noting the position of the swelling, and the presence or absence of fulness, resistance, and fluctuation in the iliac fossa and true pelvis. *Morbus coxæ* (page 365) is the most frequent cause of femoral abscess, and the surgeon should therefore examine the joint for signs of that disease. If, when fully flexed, movement of the joint laterally and in rotation be free and painless, and pressure upon the trochanter or lower end of the femur does not excite pain, but extension is painful and limited, a deep fluctuating swelling in Scarpa's triangle is *suppuration in the ilio-psoas bursa.* (*See* page 371.) When, with signs of morbus coxæ, the swelling occupies the fold of the groin and bulges above that fold, it points particularly to *disease of the acetabulum.*

If the swelling be mainly in the belly, along the course of the psoas muscle, and be pointing in the thigh internal to the femoral artery, and there be a wave of fluctuation between the two parts of the swelling, and a distinct impulse in the femoral swelling when the patient coughs, it is a *psoas abscess.* To discover the cause of a psoas abscess, examine the spine for caries (page 397), the sacro-iliac joint, and the chest on the same side for fluid in the pleura; examine the urine for pus, albumen, casts, blood, gravel or crystalline deposit, and enquire for a history of attacks of pain shooting from the loin into the groin and testicle.

Caries of the spine is the most common cause of psoas abscess; an empyema may burst into the sheath of the muscle and point at the groin, as may also a perinephritic abscess whether primary or secondary. An abscess from sacro-iliac disease may form in the psoas muscle. In some cases neither of these causes is to be made out, and the suppuration may be ascribed to an injury to the muscle or to a primary psoitis.

If the abscess fill out the iliac fossa, and project above Poupart's ligament near the iliac crest, with or without a part extending beneath that ligament to the thigh outside the femoral vessels (this femoral swelling having an impulse on coughing, being in part or in whole reducible, and having a wave transmitted to it from the swelling in the belly), it is an *iliac abscess.* This may be connected with disease of the *sacro-iliac joint* or *spine*, *necrosis of the ilium*, *injury*, *inflammation* or *ulceration of the cæcum*, or *rupture* of part of the *muscle. Perityphlitis* will be recognised by the abscess filling out the right iliac fossa, and not spreading down into the thigh, for the pus is not beneath the iliac fascia; there may be emphysematous crackling of the swelling, or a tympanitic percussion note which will render the diagnosis very certain. The author recently saw a fæcal abscess in this situation following a blow in the groin.

Where an abscess pointing in the groin is associated with symptoms of pelvic mischief, a careful examination should be made of that cavity per anum or per vaginam, and where a swelling is found with a wave of fluctuation passing from it to that in the groin, it will be recognised as a *pelvic abscess.* Pelvic cellulitis is much more common in women than in men. These abscesses may point in the inguinal canal and pass into the scrotum (page 522).

If the swelling be placed below the fold of the groin internal to the femoral artery, be smooth, and rounded in outline, compressible and easily reducible by direct pressure, and reappear from below when pressure is made just above it, it is a *varix of the saphena vein.* Any of the superficial veins of this region may be varicose. (*See* page 295.)

If there be a history of a femoral hernia (*see* page 464), and this have been succeeded by a tense fluctuating swelling at the same situation, without cough-impulse, not reducible, and there be no signs of strangulated hernia, it is a *hydrocele of the sac of a femoral hernia.* This is very closely simulated when a small knuckle of intestine is nipped in the femoral ring, and the sac beyond becomes distended with fluid; there will, however, be the signs of intestinal obstruction to guide the surgeon. Hydrocele of the sac may be attended with constipation and vomiting.

If a tense fluctuating swelling be found occupying the inguinal canal, without signs of intestinal obstruction, it is an *encysted hydrocele of the cord.* (*See* page 521.)

If the tumour be congenital or first noticed in early life, be soft, lax, irregular in outline, more or less adherent to the surrounding tissues, stationary or slowly enlarging, and perhaps attended with attacks of inflammation from time to time, it is a *cystic hygroma.*

If the tumour be chronic, adherent to the skin, fluctuating, tense, globular in shape, painless and free from tenderness, it is a *sebaceous cyst.*

(For the diagnosis of pulsating tumours, *see* chapter xviii.)

The tumour is solid.—It may be a *hernia,* an *imperfectly descended testicle,* or a solid enlargement of one or more of the tissues of the part. If there be congenital absence of the testicle from the scrotum, and an ovoid firm tumour of about the size of the testicle be felt in the inguinal or crural canal, or in the iliac fossa close to Poupart's ligament, and especially if pressure upon it cause the peculiar "testicular sensation," it is an *undescended testicle.* If an undescended testicle be not in either of these situations it may be found in the perineum. The testicle may be fixed or may slip up and down the inguinal canal and give a thrusting impulse on coughing. Hernia is often associated with this condition; a softer consistence, a gurgle, a tympanitic percussion note, or a granular feel, together with true reducibility and expansile impulse, will distinguish it from the testicle. A misplaced testicle may be acutely inflamed, or the seat of malignant disease. The congenital absence of the testicle from the scrotum on the same side will be the key to the diagnosis.

An *inflamed retained testicle* may simulate a *strangulated hernia,* and the latter may coexist with an undescended testicle. In *orchitis,* the local pain and tenderness are greater than in hernia; if there be nausea and vomiting the latter does not become stercoraceous, nor is it urgent, and the constipation is not absolute, while the general symptoms are febrile. The surgeon may also find an urethral discharge, or a history of direct violence. If, therefore, the suspected tumour be tense, well defined, with dragging pain referred to the umbilicus, moderate tenderness, urgent vomiting which becomes stercoraceous, and absolute constipation with signs of collapse, the diagnosis should be *strangulated hernia.*

Having excluded this condition, the inguinal and crural canals should be examined for *hernia.* (*See* page 463.) It is only needful here to refer to *hernia of the ovary* into the inguinal canal (it may pass into the labium), which is recognised by the presence of a small ovoid tumour which swells and becomes painful at each menstrual period, and by the absence of the ovary in the pelvis, as proved by bimanual examination.

A swelling deep under the origin of the adductor muscles, and fixed to the pelvis, may be an *obturator hernia.* (*See* page 464.)

The lymphatic glands are arranged in two sets in superficial fascia, one along Poupart's ligament (inguinal), the other along the saphena vein (femoral), and there is a deep gland occupying the crural canal; by pressure in the iliac fossa the deep inguinal (or iliac) glands when enlarged can be felt along the external iliac artery. The position and the outline of the swelling, together with, in most cases, some local cause of infection in the urethra, penis, scrotum, perineum, buttock, groin, or lower limb, or the coexisting enlargement of other groups of glands, will enable the surgeon to diagnose a *glandular swelling.* (*See* page 283.) When many glands are moderately enlarged, firm, quite movable under the skin and over the deep fascia, without pain, tenderness, or other obvious sign of inflammation, they are known as *indolent buboes;* these are met with following hard chancre, and are sometimes spoken of also as *amygdaloid.*

When a gland is enlarged, painful, tender, fixed to the skin and deep fascia, and its outline, owing to surrounding œdema, is ill-defined, and a source of infection such as a sore on the toe, gonorrhœa, or a soft chancre is found, it is known as a *sympathetic bubo;* the skin over it is hot and reddened, and there is a tendency for the gland to suppurate. Exactly similar enlargements are sometimes seen as the result of strain and over-exertion. If the swelling spread from gland to gland, and they are massed together into one irregular tumour, which slowly enlarges and then softens and fluctuates at places, it is a *scrofulous bubo;* this condition may be started by infection, simple or syphilitic. In some cases of malignant disease the glands are enlarged from simple irritation, and the swelling subsides when the primary tumour is removed.

Of the remaining tumours in this situation it is only necessary to point out that a hard swelling in the adductor muscles, close to the pubes, chronic and painless, is a "*rider's bone*," or an ossification of the tendon of the adductor longus or magnus muscle. "*Rider's sprain*" (*see* page 35) may occasion a considerable firm swelling in the adductor muscles, lasting some time after the injury. *Lipoma* may be met with in the superficial fat, and *enchondroma* or *sarcoma* may be found growing from the pelvis or thigh bones, and the latter also from the fascia and muscular aponeurosis. (*See* chapters xvi. and xix.)

CHAPTER XLII.

DIAGNOSIS OF DISEASES OF THE URINARY ORGANS.

In investigating any case of disease of the urinary organs the surgeon should proceed systematically, for this will both guard him from error and economise time. Although the symptoms and signs of these affections are numerous, they may all be grouped into four classes, and the surgeon should conduct his examination in four directions. He should first investigate the patient's *pain*, then study the *act of micturition*, then examine the *urine passed*, and, lastly, proceed to investigate directly the *urinary passages, the bladder, and the kidneys.*

I. **Pain** is associated with nearly all diseases of the urinary organs. It owns the same causes and has the same general significance here as elsewhere, but the *seat*, *time*, and *character* of the pain are of considerable diagnostic importance. Pain may be either *local*, *i.e.* produced at the painful part, or *referred*, *i.e.* produced at a distance. The *referred pains* are recognised by the absence of all other signs of disease at the painful parts, and also by the special seats of these pains. They are experienced at the end of the penis, usually just behind the glans, which is found quite normal, being "referred" there from the neck of the bladder; or they are felt in the testicle, groin, and down the thigh, being "referred" to these regions from the kidney, the pelvis of the kidney, and the ureter; this is commonly associated with marked retraction of the testicle. These "referred pains" are especially caused by the irritation of calculi and other foreign bodies. In *children* the pain "referred" to the end of the urethra is shown by the patient pulling at the penis, often drawing out the foreskin to a considerable length, or by scratching at the vulva. Of the *local pains* it is only necessary to say that pain in the *prostate* is felt in the perineum and rectum, and is excited by the passage of large and hard motions, or by the contact of the finger in the rectum; pain in the *bladder* is felt above the pubes, deep in the perineum, and also extending to the groins, and round the back to the sacrum; renal pain is felt in the loins.

When the pain is felt.—The pain may be *spontaneous*, *i.e.* quite independent of movement on the part of the patient, of micturition, erection, or defæcation; such pain may be due to inflammation of the organs, to the contact of foreign bodies and calculi, to the growth of tumours and to over-distension. Many painful conditions do not give rise to "spontaneous pain." When pain is *increased during micturition* it shows that either the contraction of the bladder or the passage of the urine along the urethra is painful, and we therefore have this symptom in acute cystitis, acute prostatitis, urethritis, and stricture of the urethra, and sometimes also in phymosis. When pain is *increased at the end of micturition* it shows that the contraction of the bladder down upon its neck is painful, and we therefore meet with this in stone in the bladder, in prostatitis, and in ulcer and fissure of the neck of the bladder. A dragging pain in the bladder, felt only at the end of micturition, may be caused by adhesion of the bladder to surrounding structures: the diagnosis will be assisted by evidence of pelvic cellulitis or peritonitis. Where pain is *diminished after micturition* it points to the contact of the urine with the bladder, or the distension of that organ as the cause of the pain, and this we see exemplified in acute cystitis and in retention of urine. Nearly all pain is *increased by movement*, but where this is a marked symptom it points to the cause of the pain being a movable body, and hence we find this especially in cases of stone in the bladder and in the pelvis of the kidney. Adults are usually able to give clear information on this point at once, as they have noticed the influence upon their sufferings of a railway journey, or a ride in a rough cart, or coming downstairs. In children the same thing is shown by the patient avoiding rough games or any unnecessary movements, or crying when made to move, and it may be tested by getting them to jump down from a table and chair; if they do this freely and without any sign of pain, stone in the bladder may be excluded with almost absolute certainty. When the pain is *increased by defæcation* it shows that the painful part is at the base of the bladder or the prostate, as in prostatic inflammation. The pain is, of course, more marked when the motions are large and hard. *Erection of the penis* causes pain, either by stretching an inflamed urethra, by adding to the congestion of an inflamed prostate, or, when part of the erectile tissue cannot expand, by the great tension to which it is subjected. It is an indication, therefore, of urethritis, of prostatitis, or of an obliteration of part of the corpus spongiosum or corpus cavernosum. When due to stretching of the urethra, a tight pain is felt all along the under surface of the penis, and the organ is more or less curved down; when due to prostatitis, the erection of the penis is perfect, and the pain is felt deep in the perineum; when due to obliteration of part of the erectile tissue, the penis is sharply bent to one or other side or directly downwards. This symptom is commonly known as *chordee*, although this term should only be used when the penis is bent, as well as painful in erection.

The character of the pain.—The pain of acute inflammation is described as sharp, pricking or smarting, while that of chronic inflammation is of a dull aching character; that due to foreign bodies or calculi is more often spoken of as sharp, cutting or burning; a straining pain, or "tenesmus," which may be very severe, is particularly experienced in acute cystitis and in foreign bodies in the bladder. When pain becomes throbbing in character it is an useful indication of suppuration having occurred. Severe colicky pain in the loin and shooting down to the groin and testicle attends the impaction or passage of a calculus in the ureter.

II. **The act of micturition.**—In health, when the urine has distended the bladder to a certain extent, a stimulus is transmitted to a centre in the lumbar enlargement of the spinal cord and there reflected along motor nerves to the muscular coat of the bladder, and at the same time the contraction of the sphincter muscles is inhibited. This reflex centre is under the control of the will, and the act can be excited or inhibited by the will, which also increases the expelling force by throwing into contraction the abdominal muscles. The resistance to be overcome is that offered by the urethra, and the shape of the issuing stream is determined by the meatus urinarius. A knowledge of these facts enables us to understand how the act may be modified. Nearly all the affections of the urinary organs cause *frequency of micturition.* This may be caused by *increased stimulation* of the bladder by acid urine, or by calculi and foreign bodies; by *undue irritability* of the bladder, as in all forms of cystitis, and also prostatitis; by a *small size* of the bladder, so that a few ounces of urine distend it; by *failure to empty* the bladder, when, as in the last case, the addition of a small quantity of urine to that retained in the bladder distends it to the full; by *irritation of other parts* of the urinary apparatus, as in renal inflammation and calculus, urethritis, and phymosis; by *instability of the centre* in the spinal cord whereby it responds to stimuli of too feeble force; this is seen in the nocturnal "incontinence" of children, and in the effects of sexual excess; and, lastly, by *stimuli from the brain*, as in some cases of hysteria and some forms of "nervousness." The frequency due to the irritation of calculi and foreign bodies is increased by movement; that due to over-distension of the bladder and atony is increased by rest, and is therefore more marked at night.

Micturition should be a conscious act; it may be *unconscious*, through an *interruption in the path of sensation* in the cord (*see* page 102), or through the reflex centre responding to a *stimulus not powerful enough to excite sensation*, as is seen in the nocturnal "incontinence" of children; or by the *bladder leaking*, as occurs in cases of great over-distension from atony, when the sphincter action is interfered with and urine leaks or dribbles out into the urethra; this leaking must be distinguished from the expulsive act of micturition. *Unconscious micturition* is often spoken of as "involuntary." The surgeon must not mistake frequency of micturition or unconscious micturition for "incontinence of urine," a condition of extreme rarity only met with in extroversion of the bladder, large recto-vesical or vesico-vaginal fistula, and in paralysis.

The *force of the stream* depends upon the expelling power of the bladder and abdominal muscles, and the obstruction offered by the urethra; this force is estimated by the distance to which the stream can be propelled from the body. It may be *increased* by very powerful contraction of the bladder, as is sometimes seen in vesical calculus; it is far more often *diminished* by *atony* of the bladder, *hypertrophy of the prostate* or *tight stricture.*

The *size and shape* of the stream depend upon conditions in the urethra. Where there is stricture the stream may not fully distend the meatus, and then will not be shaped by it, but may be twisted or bifid. The stream may be reduced to a mere succession of drops.

The *duration* of micturition is increased by stricture, by atony of the bladder, and by enlargement of the prostate. Patients often complain of a difficulty in beginning to pass water, this is owing to an interference in the nervous mechanism; a difficulty in "leaving off," or a dribbling continuing after the close of the voluntary act is seen in cases of over-distension of the bladder with "residual" urine. A *sudden interruption* in the act is a very rare symptom caused by a stone in the bladder blocking up the neck.

The escape of urine from other orifices than that of the urethra is evidence of *urinary fistula,* which will be named according to its position, viz. perineal, scrotal, rectal, vaginal, etc.

Retention of urine is a condition characterised by inability to empty the bladder. It may be *complete* or *partial*, and as the latter is often associated with involuntary or frequent micturition, it is overlooked by the patients, and may be mistaken by the surgeon unless he remember that "dribbling arises from overflow" in the vast majority of cases. *Complete retention* has only to be distinguished from *suppression of urine*, *rupture of the bladder*, and *extravasation of urine*. It is characterised by the presence of a full bladder, as felt per rectum and above the pubes, and usually by a painful desire to pass water, while the introduction of a catheter is followed by the escape of a large quantity of urine, and relief of the pain. In the other conditions there is no bladder tumour, and on passing a catheter, either no urine, or only a few drops of bloody urine are drawn off; or it may be impossible to get the catheter into the bladder when the uretha is quite torn through. In *suppression of urine* there are characteristic general signs, such as coma and convulsions; in *rupture of the bladder* there is a history of an accident or of long previous retention, with a sense of sudden yielding (*see* page 167), and in *extravasation of urine* there is the characteristic swelling. (*See* page 502.)

Partial retention is characterised by frequency of micturition, by loss of force in the stream, and often by dribbling of urine or inability to prevent the escape of a few drops of urine during coughing or effort. These symptoms are worse at night; after the patient has tried to empty his bladder the catheter draws off the "residual urine."

The *causes of retention* are *nervous*, *muscular*, or *obstructive*. *Nervous retention* is caused by inhibition of the micturition centre by some strong stimulus, such as that caused by an operation on the rectum or urinary organs, or even any injury or operation, by severe pain in the act of micturition as in acute urethritis, and also in hysteria. The retention sometimes seen in acute over-distension may be in part due to exhaustion of the lumbar centre. This form of retention is characterised by its suddenness, its completeness, its evident relation in most cases to an injury or operation, and the absence of all "obstruction." *Muscular retention* is due to over-distension of the bladder paralysing the muscle, to atony of the bladder, and perhaps to prostatic growths interfering with the action of the muscle. It is characterised by being chronic (except in cases of acute distension), generally partial, or attended with "dribbling," and by the feeble power with which the urine flows from a catheter; indeed, the bladder may be quite unable to expel its contents, and the surgeon may have to force out the urine by pressure above the pubes. *Obstructive retention* may be *traumatic* or *idiopathic;* fracture of the pelvis, subpubic dislocation of the hip, and rupture of the urethra are the injuries leading to it. The idiopathic causes are calculi and foreign bodies blocking the passage, inflammatory swelling, or stricture of the wall of the urethra, and tumours pressing upon and blocking up the passage. The obstruction from calculi, etc., is sudden; from inflammation it is acute and attended with other obvious signs, such as pain, swelling, and discharge; from stricture or tumours it is chronic, or preceded by difficulty in micturition or diminution of the force or size of the stream. The history of the case and the age of the patient usually suffice to enable the surgeon to diagnose the case; the previous occurrence of urethral discharge, or of a small or feeble stream, of pain after micturition, or renal colic, or the operation of lithotrity, is to be enquired for. In children, retention is most often due to impaction of a calculus; in young men it is generally due to urethritis, prostatis or abscess; in middle-aged men it is most often due to stricture ·

and in elderly men to hypertrophy of the prostate, or stone.

III. **The urine.**—A full consideration of the best modes and the diagnostic value of an examination of the urine would demand far more space than can be allotted here, and for this the reader is referred to the many well-known manuals on the subject, and especially to Ralfe's "Clinical Chemistry." An examination of the urine should consist of a quantitative estimate of the normal constituents of the fluid, and then of a search for any adventitious substances added to it, or for changes occurring in it before it is voided. Of the first we shall say nothing here, except to emphasise the fact that few observations are of greater clinical importance than the estimation of the daily excretion of urea. Urine is normally an acid fluid; if passed alkaline it may be from an alteration of the secretion and dependent upon excess of fixed alkali, or from decomposition of urea into volatile alkali or carbonate of ammonia. The odour and general appearance of the urine will distinguish between these two states, and if a slip of test-paper discoloured by the alkali be gently warmed over a spirit lamp it will regain its original colour if the alkali be volatile, but will retain its new colour if the alkali be fixed.

For purposes of quantitative analysis a sample from the whole amount of urine passed in twenty-four hours should be examined. For qualitative examination, the urine should be passed in three separate glasses, the first to contain the first two ounces passed, the next the great bulk of the urine, and the last few drops or so should be passed into a third glass. In the first glass will be bladder urine *plus* adventitious matters from the urethra; in the second glass will be the average urine; and in the third glass will be the urine *plus* any sediments deposited in the bladder, or blood escaping at the end of the contraction of the bladder.

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Albuminuria may be due to the admixture of blood or pus with the urine, or to some condition of the kidneys, their blood-vessels, or the blood, leading to a filtration of blood serum. Wherever albuminuria is unattended with the presence of blood or pus cells in the urine, it is due to some original fault in the renal excretion, and this is corroborated if "tube-casts" of any kind be found. And where the amount of albumen is out of proportion to the number of blood or pus cells seen, the same inference is to be drawn. For further information on simple albuminuria the reader must consult works on medicine.

Hæmaturia is most certainly shown by the detection of blood corpuscles in the urine. The surgeon must first *decide the source of the blood*, whether urethral, vesical, or renal. If the blood escape involuntarily and independently of the act of micturition, or pass with the first few drops of urine only, or if the escape of urine be preceded by the passage of a long clot the size and shape of the urethra, the blood is *urethral*. The most common cause of urethral hæmorrhage is injury, catheterism, etc. When the blood flows with the last few drops of urine, it certainly comes from the *prostate* or *neck of the bladder*, and its cause will be inflammation or congestion of the prostate or calculus. The history of the case, particularly the existence of urethritis, gleet or stricture, the examination of the prostate or the passage of a sound will decide the diagnosis. In extensive bleeding from the prostate the blood flows back into the bladder, and it is not then to be distinguished from vesical hæmorrhage except by other signs of prostatic disease. When the blood is not intimately mixed with the urine, but becomes more abundant towards the end of the act, or when the urine contains flat or irregular-shaped clots, or is reddish in colour, it may be assumed to be *vesical hæmorrhage*. The causes of vesical hæmorrhage are stone in the bladder, tumours of the bladder, acute cystitis, tubercular and cancerous ulceration of the bladder, rupture of a vesical varix, and perhaps hæmophilia, purpura, and scurvy. The hæmorrhage from *stone* is moderate and often very small in amount, intermittent, especially excited by exercise and accompanied by the characteristic pain, etc. The hæmorrhage of *vesical tumour* is often very abundant, indeed, the source of the most abundant vesical hæmorrhage is bladder tumour, especially "fimbriated papilloma," of which it is the first and most marked symptom, and it is very characteristic for the urine to become more and more bloody as micturition proceeds, until at length pure blood is passed as the bladder contracts upon the growth. The hæmorrhage of *acute cystitis* is moderate in amount and accompanied by intense pain and frequency of micturition, and the urine contains mucus and pus. In *tubercular ulceration* there are generally signs of tubercle in the kidney, prostate, testicle, or vesiculæ seminales. The urine should be examined for bacilli. In *cancerous ulceration* there is often profuse hæmorrhage at intervals, generally the patient has previously suffered from pain and frequency of micturition, and there may be cachexia. *Vesical varix* is a very rare condition characterised by occasional profuse hæmorrhages, and only to be diagnosed when all other causes of hæmorrhage can be certainly excluded. Other signs of *purpura, scurvy,* and *hæmophilia* accompany bleeding from these causes.

Where the blood is intimately mixed with the urine, there being no difference in colour in that contained in the three vessels, or if the urine have a smoky tint, or if there be long narrow clots ("casts" of the ureter), it is certainly *renal* in origin. Renal and prostatic hæmorrhage may closely simulate vesical hæmorrhage, and be only distinguishable from it by other signs of disease of these organs. Renal hæmorrhage may be due to injury, acute inflammation, stone, tubercle, cancer, parasites, or blood changes. The history of the case decides whether it is due to *injury*. When due to *inflammation*, it is accompanied by excess of albumen, by tube casts, and is usually associated with œdema and other signs of blood change. Hæmorrhage due to *stone* is chiefly characterised by its being increased by exercise or movement, by the pain, and sometimes by the passage of gravel. Hæmorrhage due to *tubercle* is recognised by the detection of tubercle elsewhere, by fever, and by the admixture of pus with the blood. The hæmorrhage of renal *cancer* may be very profuse or very slight; the formation of a renal tumour leads to its diagnosis. The signs of *hæmophilia*, *scurvy*, *purpura*, *fever*, and the causes of *renal congestion* are so apparent that the diagnosis of hæmorrhage from these sources is easy. Hæmorrhage as a part of *chyluria*, is recognised by the fibrinous coagula, the milky colour due to fat, and possibly by the detection of filariæ in the blood.

Pyuria.—Pus is a frequent addition to urine, and is recognised by turbidity of the urine, by the presence of albumen and pus cells, and, when the pus deposits in quantity, by the fact that liquor potassæ converts this deposit into a very ropy tenacious fluid. If the pus be found only in the first of the three glasses of urine, or escape from the penis independently of micturition, it is *urethral*, either due to *catarrh* of the mucous surface, or to *abscess* opening into the urethra. Small opaque threads and flakes passed with the first few drops of urine are evidence of *gleet* with lodging of the discharge in the deeper parts of the urethra. A sudden discharge of pus in the urine indicates the bursting of an *abscess*, the seat of which will be shown by swelling and pain ; if the act of micturition end in the passage of a small quantity of pus, it points to suppuration in the *prostate.* The passage of very ropy *muco-pus* in alkaline foul-smelling urine shows that there is *catarrh* of the *bladder;* where the pus is in excess of the mucus it is called *suppuration* of the *bladder.* Pus without mucus in acid, undecomposed urine, is derived from the pelvis of the *kidney*, or more rarely, from an abscess opening into the bladder or ureter.

Mucus is a normal constituent in urine: it is increased in amount in inflammation of any part of the urinary tract. *Semen* may normally be found in small amount in urine, but especially after a seminal emission. The passage of *flatus* or of *fæcal* matter recognised by the animal and vegetable fibres and cells as well as by its colour, consistence and odour, shows that there is a communication between some part of the alimentary canal and the bladder; this condition is attended with extreme pain, sometimes by retention, and it always leads on to cystitis. The surgeon must endeavour to determine what part of the intestine opens into the bladder by the colour and consistence of the fæcal matter. This communication may be a congenital malformation, but is more often due to cancerous ulceration, to typhoid ulceration, or to pelvic abscess: the history of the case clears up the diagnosis. For the diagnostic significance of *bile* in the urine, and of the various *crystalline deposits*, the reader must refer to other works. The passage of *hair* or of masses of sebaceous matter indicates the opening of a *dermoid cyst* into some part of the urinary apparatus. *Echinoccus* hooklets have been found in urine and *hydatid vesicles* have been passed *per urethram.*

Where the symptoms point to the presence of a *tumour of the bladder*, the deposit must be carefully and repeatedly examined microscopically. The presence of a large quantity of bladder epithelium or of irregular polynucleated cells corroborates the suspicion; but if a villus or fragment of the growth can be detected, it establishes the diagnosis: such fragments are recognised by their shape and size, and especially by the regular arrangement of the epithelium, or by the detection of a capillary. The shreds may be found in the urine passed naturally, or one may be removed in the eye of a catheter; but the best way to obtain them is, after emptying the bladder, to introduce an evacuating tube, and to wash the bladder out with warm water by means of an exhausting bottle.

IV. **Examination of the urethra, prostate, bladder, and kidneys.**—A. **The urethra and prostate.**—The orifice of the urethra may be found at the base of the glans penis (a very common deformity) or more rarely at the root of the penis, or in the perineum, the scrotum being split: these conditions are all varieties of *hypospadias.* The state of the orifice, and the presence of discharge, if any, are to be noticed. The orifice may be too small (*stricture of the meatus*), or *warts, chancre* or *epithelioma* may be seen on it. (*See* page 498.) Should the orifice be swollen and covered with a gummy discharge, and be the seat of itching and smarting, and these signs be noticed two to seven days after coitus, it is the *initial stage of acute urethritis.* If there be an abundant thick yellow or greenish discharge, and the penis be swollen, and the urethra feel hard and tender, there is *acute urethritis;* when the discharge becomes milky in colour, and the pain and swelling subside, it is called *chronic urethritis;* and if the discharge consist only of shreds voided in the first portion of the urine, or of a drop of gummy discharge at the meatus seen perhaps only in the morning, it is *gleet.* If the discharge be sanious, and an ulcer is seen just within the orifice, it is a *soft chancre.* A sero-purulent discharge with little or no pain, associated with a firm lump in the urethra near the orifice, multiple enlargement of the inguinal glands, and followed by sore throat and a rash, is due to a *hard chancre.* *Gonorrhœa* is distinguished from other forms of urethritis by the long incubation period (from 2 to 7 days), and by the intensity of the symptoms. A painless muco-purulent discharge is sometimes seen in secondary *syphilis.* Gouty, traumatic and non-specific urethritis are to be distinguished by the history and concomitant affections. *Gleet* may be caused by chronic urethritis or prostatitis, by a stricture, or an urinary fistula. Now let the surgeon pass his fingers back along the urethra to the perineum; it is found swelled and tender in acute urethritis, or hard and knotty in severe stricture; if a painful and tender ill-defined firm swelling be felt in the anterior perineum, it is a *perineal abscess;* in its later stages fluctuation may be felt. A similar swelling with much surrounding œdema may be found over the urethra where it is covered by the scrotum; the pus being under the ejaculator urinæ muscle, the abscess then points at the root of the penis.

Then pass the finger into the rectum and feel the prostate; if it be found acutely tender, hot and swelled, there is *acute prostatitis,* and if the swelling be soft and fluctuating it is a *prostatic abscess.* But if it be found enlarged, notice its size, outline and consistence. If the patient be over fifty-five years of age and the enlargement be firm and rounded, it is probably *hypertrophy* of the organ; but if the enlargement be very great, or increase rapidly, be irregular in outline and consistence, and especially if there be hæmaturia and enlargement of the pelvic and lumbar glands, it is *malignant disease of the prostate.* A nodular enlargement of the prostate in a young or middle-aged man is probably *tubercular*, and if tubercle be found in his lungs or testicle, or the vesiculæ seminales are found enlarged, or the bladder and kidneys are affected, this diagnosis is certain. The prostate may be found *atrophied.* At the same time the finger should examine the base of the bladder and the seminal vesicles. The tense rounded base of a distended bladder, or a vesical calculus, or a vesical tumour, or a nodular enlargement of the seminal vesicles (one or both) from tubercle may thus be detected; this examination is much facilitated by firm suprapubic pressure. If a firm, well-defined tumour be felt in the bladder it is cancerous; the benign tumours are softer and more ill-defined.

A full-sized catheter or bougie should now be passed, and the fact of undue pain or of obstruction noticed. Sharp pain at a particular spot in the urethra points to a *local inflammation*, and is an useful indication of the source of a gleety discharge or perineal pain. If obstruction be met within six inches of the meatus it is generally due to *stricture;* obstruction beyond that point is usually from *prostatic enlargement*, and if this obstruction be overcome by depressing the shaft of the catheter, or when an instrument is in the bladder the shaft be found to be greatly depressed, it points to what is called enlargement of the *middle lobe* of the prostate. The length of the urethra is to be measured by the length of catheter introduced before the escape of urine. When *stricture* is met with the surgeon has to notice the position, size, and number of the narrowings.

The examination is best made with "acorn" or "bullet-headed" graduated probes, or Otis's "urethrameter"; if the meatus be narrowed this may have to be incised as a preliminary measure. The resistance offered by a stricture is more clearly perceived by one of these instruments than by an ordinary bougie, but they are especially useful in the detection of multiple strictures, for a narrowing through which the bulb has passed does not grasp the slender stem, and so the onward movement becomes again easy, unless a further stricture is met with.* Any narrowing or resistance offered to the passage of an instrument, which passes off when the patient is under the full effects of an anæsthetic, is due to *spasm.* Spasm can also sometimes be diagnosed by noticing the sudden yielding of a stricture under the gentle continuous pressure of the end of a bougie. Obstruction to the passage of urine or of a bougie due to swelling of the mucous membrane is sometimes called *congestive stricture;* it is met with in urethritis, acute prostatitis, and peri-urethral abscess. Urethritis is recognised by the discharge; prostatitis by the pain in and swelling of that organ; peri-urethral abscess (prostatic or perineal) is recognised by pain, swelling, and in some cases by fluctuation.

If in passing a catheter a grating be felt, it shows that there is an *urethral* or *prostatic calculus,* and the exact position at which the grating occurs, as measured by the stem of the catheter, distinguishes between these two. If, as the catheter is passed, a sudden flow of pus occurs, it shows that a *peri-urethral abscess* has been opened; these are most commonly prostatic, but the position of the abscess is easily ascertained by the detection of swelling. If on passing a catheter the shaft be found to deviate from the middle line, or the instrument pass in to its full length without reaching the bladder (except in cases of prostatic hypertrophy), pass the finger into the rectum, and if the catheter be felt very superficial, or to one or other side, it has passed into a *false passage.* If, when the surgeon is trying to overcome an obstruction, the catheter suddenly slip on with a soft grating sensation, and blood escape, he knows that he has made a false passage; an instrument is never grasped by a false passage as it is by a stricture or by the compressor urethræ muscle.

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* There is difference of opinion among surgeons as to what may be held to constitute a pathological narrowing of the urethra.

B. **The bladder.**—For signs of a distended bladder, *see* page 292. The *capacity*, *competence*, and *power* of the bladder, and the presence in it of *foreign bodies* or *tumours*, are the facts to be ascertained by examination of the bladder. If, immediately after the patient has passed water, a catheter be passed and urine flow off, the *bladder is incompetent*, and the amount of the "residual urine" should be measured; if the urine flow through the catheter slowly and feebly there is *atony of the bladder*, but should it be propelled with normal power the chronic retention of urine would then be due to *obstruction* to its outflow, either urethral stricture or hypertrophy of the prostate. In the large majority of cases "residual urine" is a sign of atony. If the amount of residual urine be added to that passed by the patient, and the total measured, it will give the capacity of the bladder. As we have seen, frequency of micturition is not a sure sign of small size of the bladder; but if the frequency be chronic and the bladder be competent, the bladder is undoubtedly small; the amount of fluid that can be injected into the bladder without meeting with resistance, and the freedom with which a sound or a lithotrite can be manipulated in the bladder, are other means of estimating the *capacity* of a bladder. A small bladder is met with in old tight stricture, in stone in the bladder, in some cases of chronic cystitis, and in long-standing vesical fistula. It is important to know the size of the bladder before performing lithotrity or lithotomy.

If, on drawing off the water, the flow cease and the bladder apparently be empty, but on pushing the catheter in a little farther or moving it in the bladder, some more urine flow out, especially if it be different in appearance to that before drawn (alkaline, purulent), a *sacculus* may be diagnosed. A sacculus is also to be diagnosed when, on emptying the bladder, a fluctuating swelling is felt above the pubes, from which, by pressure, urine can be expelled through the catheter.

The next step in diagnosis will be to explore the bladder with a *sound.* This should first be done with the bladder moderately full, and then, if no stone be detected, with the viscus empty, and for this reason a hollow sound is convenient. As the sound passes into the bladder it may grate over an urethal or prostatic calculus. If the end of the sound be freely movable from side to side the surgeon knows it is in the bladder. It is possible to fall into error by passing the sound into a false passage, or no farther than the dilated prostatic urethra. An audible click and a feeling of firm resistance are the signs of *stone in the bladder.* The surgeon must not mistake for this, mere roughness of the bladder, *fasciculated bladder*, which gives rise to no click; or soft *sabulous matter*, which causes a soft grating sensation; or contact with the *sacrum or ischial spine*, which also does not give a click, but only a feeling of resistance; or a *tumour*, which occasions more or less resistance to the free movement of the sound, but does not give a click or grating sensation. The "sound" of a stone in the bladder, therefore, is the safe test of its presence. A stone may be missed by an incomplete examination of the bladder, or by its being covered over with a fold of the mucous membrane or a thick layer of blood clot or mucus.

A *stone in the bladder* being diagnosed, the surgeon must determine the nature, size, number, and position

of the calculi. An examination of the urine will dete
mine the composition of the outer crust of the ston
while the history of the case, and the prevailing co
dition of the urine, if known, will tell the probabl
composition of the nucleus and bulk of the calculus
If the urine be acid, and deposit uric acid and urate
on cooling, the calculus is *uric acid and urates.*

If the deposit consist of *oxalate of lime* the cal
culus may be assumed to be of that nature; whil
alkaline urine, with deposit of phosphates, will indicat
that at any rate the crust of the stone is *phosphatic.*
If the stone be felt to be smooth, and give a shar
click, it is *uric acid;* if it be rough or nodular, an
give a clear click, it is *oxalate of lime,* and if it give
softer duller sound, it is *phosphatic* on the exterior.
Calculi known to be formed around foreign bodies in
the bladder are *phosphatic* on the exterior. Calculi in
children are generally composed of *uric acid or urates.*

The *size of a stone* is best ascertained by grasping it in a lithotrite two or three times, and measuring the distance apart of the blades. It may be more roughly estimated by passing a sound to one extremity of it, and marking the level of the urinary meatus on the stem, and then drawing the sound over to the opposite end, and again marking the meatus; this should be done in two directions.

The *number of stones* present.—Usually there is but one. The sound may at once detect a great number, giving a sensation as if in a bag of small marbles or a small "gravel pit." Or the signs of stone may be detected in two or more distinct parts of the bladder. The most certain evidence, however, is to grasp one stone in a small lithotrite, and then use that as a sound, and if it be felt and heard to tap against another stone, it shows that two at least are present.

The *position of the stone* is a matter of great importance in view of operation. If the stone be found in different places at different times, or if the sound pass over a great area of stone, or if the stone can be grasped in a lithotrite, it is certainly *in the bladder.* But if it be detected with difficulty, or only occasionally, especially if the sound cannot be passed over more than one side of it, or if it cannot be grasped in a lithotrite, it is probably *sacculated.*

If no stone be detected the surgeon must notice carefully whether the sound meet with resistance at any part, or whether contact with a particular spot causes sharp pain (a sign of *ulcer of the bladder*), and whether the examination occasions smart hæmorrhage, which indicates a *vesical tumour.* If the resistance to the sound be distinct and firm, and an induration be plainly felt from the rectum, while the pelvic glands are enlarged, the patient emaciated, the urine containing blood, much epithelium and some muco-pus, it is to be diagnosed as *cancer of the bladder;* there is usually great pain and frequency of micturition, and these precede the occurrence of hæmorrhage. Where hæmorrhage from the bladder is the first and chief symptom, and is subsequently followed by frequency and pain, a *benign tumour* of the bladder is to be suspected, of which *fimbriated papilloma* is the commonest variety, and the one attended with most hæmorrhage.

Where a tumour of the bladder is suspected or diagnosed, or in any case of persistent pain in the bladder, or of chronic cystitis, for which neither cause nor cure can otherwise be found, *digital exploration of the bladder* should be made. In the female the urethra is dilated to admit the finger; in the male the membranous urethra is opened from the perineum, and the forefinger passed in; with the left hand or by an assistant, pressure is made above the pubes, in this way the whole interior of the bladder can be well examined. The finger will first pass over the neck of the bladder, and should feel for prostatic outgrowths, fissures and ulcers. In the bladder, tumours of various kinds, sacculated stones, stones impacted at the orifice of the ureter, sacculi and ulcers are the conditions that may be met with. The nature of most of them will be at once evident. Stone at the orifice of the ureter will be felt as a hard lump at the base of the bladder, covered all over with mucous membrane, and with the finger nail, or a pointed probe, the latter may be pierced and the stone actually felt. Care must be taken not to mistake a bladder inverted by firm suprapubic pressure for a tumour. If a tumour be found, its consistence, size, shape, exact position, and especially its mode of attachment to the bladder, must be carefully ascertained. In children, a soft, pedunculated *mucous polypus*, like those common in the nose, may be found. In adults, if the tumour be very soft, flocculent, and pedunculated, it is a *fimbriated papilloma;* if firmer and sessile, but not ulcerated, it is probably either "*fibro-papilloma*" or the *transitional* tumour of Thompson.* *Scirrhus* will be recognised by its hardness; *epithelioma* by its ragged, ulcerated surface and indurated edge and base; *encephaloid* by its rapid growth; all these three alike will be found in elderly adults, and there will probably be glandular enlargement, wasting, and cachexia. Mr. Bryant has found and removed a *dermoid cyst.* The structure of the tumour should be proved by removal of a fragment, and its microscopical examination.

C. **The kidney.**—For the methods and results of examination of the kidney, the reader must consult works on medicine. In cases of stone in the kidney, a long needle may be thrust into the organ from the loin, in the hope of striking the calculus. In the female the ureters may be catheterised after dilatation of the urethra, and the urine from each kidney collected separately in cases where it is important to determine which kidney is the seat of suppuration, and whether the other organ is functionally sound, *e.g.* tubercular disease.

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* *See* "Tumours of the Bladder," by Sir H. Thompson.

Urethral fever.—When, soon after the passage of a catheter, the operation of lithotrity, or some similar local irritation, the patient is seized with a rigor, followed by great heat of skin, and then by a profuse sweat, the temperature rising considerably during the rigor and falling to the normal during the sweat, and the whole illness passing off in a few hours, the illness is *acute urethral fever.* The attack may vary much in intensity; it resembles a paroxysm of ague or a pyæmic rigor, but is characterised by its transient character and its connection with urethral irritation. When the attack is repeated at the interval of a few hours or a few days, it is called *recurrent urethral fever.* When a patient who is using a catheter suffers from chronic pyrexia, with marked asthenia, a dry brown tongue, anorexia, mental stupor, or a low muttering delirium, it is *chronic urethral fever.* The temperature may be but little raised or vary much from time to time. This form of fever is generally met with in the subjects of chronic vesical incompetency with deficient excretion of urea. Some cases of so-called *urethral fever* are septic in origin.

CHAPTER XLIII.

DIAGNOSIS OF DISEASES OF THE HAND.

THE hand is sometimes greatly distorted by the contracting scars of a *burn;* to be distinguished from this is a spontaneous disease of the skin lasting many years, which gradually draws the fingers together and finally converts the hand into an irregular club-shaped mass, from which the ends of the fingers project; the part, which is covered by a reddish cicatricial skin, is ulcerated or covered with thick yellow crusts; this disease is a form of *lupus*. Another deformity coming on, especially in men of middle or later life, is that characterised by flexion of the fingers at the metacarpo-phalangeal joint; on attempting to straighten the digit great resistance is met with in the palm, and the palmar fascia is felt to be tense and firmly adherent to the skin, which is marked with transverse creases; this is known as *Dupuytren's contraction.*

Acute inflammation may attack any of the structures of the hand, and is characterised by its usual signs; but the surgeon must endeavour to determine its exact seat. If the pain and swelling be in the *wrist*, the joint should be very gently moved, and then while the wrist joint is fixed by grasping it firmly in the hand, the fingers should be carefully flexed and extended; should it be found that every movement of the wrist joint is very painful, but that when it is held fixed the fingers can be moved without causing pain, it will show that there is *acute inflammation of the wrist joint*. If, however, movement of the fingers be found to be painful when the wrist joint is fixed, it points to *acute teno-synovitis*, and if soft grating or friction be felt during the movement this diagnosis becomes certain. In some cases of joint disease the sheaths of the tendons become involved. In teno-synovitis the pain is more exactly localised than in arthritis and no pain is caused by gentle vertical pressure of the hand up against the fore-arm. The actual tendon affected will be ascertained by the position of the pain and swelling and by noticing what movement it is that causes the acute pain.

The palm.—When a swelling extends up under the anterior annular ligament to the lower part of the fore-arm it indicates affection of the common palmar synovial sheath. It is impossible to detect fluctuation from small collections of pus through the tense and œdematous palmar fascia and the surgeon must rely for the diagnosis of suppuration upon other signs; of these the best are œdema of the back of the hand, throbbing pain, increased swelling and pyrexia. Abscess is often met with at the clefts of the fingers.

The digits.—Acute inflammation of the digits is usually called *whitlow* or *paronychia*, as it is much most frequent in the last joint. Four forms are to be recognised. Where there are a sharp, stinging, smarting pain, moderate swelling and the quick formation of a flat bleb containing milky pus, it is the most superficial form, a simple *dermatitis*. On removing the raised cuticle the derma is seen bright red and glazed; if the disease spread to the nail that structure is shed. If the end of the finger be greatly swelled with severe aching and throbbing pain, the inflammation is deeper; if, when opened or allowed to burst, a slough of cellular tissue escape, and the sore heal up, the probe not detecting any bare bone, it is *phlegmonous paronychia;* but if, when the swelling bursts or is opened, the probe detect bare bone, and the sinus remain open until a sequestrum is removed, it is *periosteal paronychia.* When a finger or thumb is greatly swelled along its whole length, particularly on the palmar aspect where there is great pain and tenderness, and any movement of the digit causes acute pain, it may be diagnosed as acute inflammation of the sheath of the flexor tendons or *paronychia tendinosa.* When occurring in the thumb or little finger it may spread to the common palmar sheath.

Chronic disease.—Inflammation of the joint-end of a *bone* is detected by finding marked pain on pressing the suspected bone vertically against the one above it, while disease of the shaft is recognised by the swelling over and fixed to the bone. Occasionally soft grating is felt in a tendinous sheath due to chronic dry *teno-synovitis;* but more often there is effusion, and a fluctuating swelling having the shape and position of the sheath is found; when the fluid contains also small fragments of fibrin flattened out into "melon-seed bodies," the movement of the fluid imparts to the fingers a peculiar thrill-like sensation which is characteristic. These swellings may be met with on the palmar surface of the fingers or in the palm of the hand projecting below the annular ligament and also in the fore-arm above the ligament and extending usually into the thumb or little finger (*palmar ganglion*); occasionally such a swelling is seen over the back of the wrist. A tense ovoid or globular fluctuating swelling on the back of the hand is a *circumscribed ganglion*, which may be connected with one of the extensor tendon sheaths, or an articular synovial membrane.

A chronic inflammatory enlargement of a phalanx is known as *dactylitis.* If the swelling be smooth and uniform, affecting the entire bone, fusiform in shape and not showing any tendency to suppurate, it is probably *syphilitic*, and other signs of this dyscrasia must be sought to support this diagnosis. If the swelling be less regular, affecting alone or chiefly one part of the bone, and showing a tendency to soften or suppurate, it is *strumous;* this disease may lead to great shortening of the finger. An exactly similar disease is met with in the metacarpus.

If one or more of the bones of the hand undergo a steady painless enlargement, forming ovoid or globular swellings, at first firm and unyielding, but later on giving "egg-shell crackling" or becoming slightly elastic, and not yielding to treatment, the disease will be recognised as *enchondroma.* This tumour grows more often from the interior than from the surface of these bones, is often multiple, and occurs in early life. When it appears as a pedunculated outgrowth from the surface of the bone at the junction of epiphysis and diaphysis it quickly ossifies. A commencing enchondroma cannot be distinguished from periostitis; but the absence of injury as an exciting cause, of pain or tenderness, of the syphilitic or strumous dyscrasia, and also the persistent growth in spite of treatment, will clear up the case; "egg-shell crackling" at once establishes the diagnosis of tumour.

When the joints of the fingers become semi-flexed, adducted, stiff and painful, with creaking and grating in the joints, and nodular thickening around, the disease is *arthritis deformans.* (*See* page 362.)

The nails may be found very brittle or irregular, with nodular thickening near the free edge; both conditions are the result of *syphilis;* occasionally from syphilis the nail is partially or wholly separated from the matrix, and slowly shed. If the end of the finger be bulbous and reddened, the nail discoloured and out of shape, and beneath it is seen a foul ulcer of the matrix with dark discharge, it is *onychia maligna;* enquiry should be made for evidence of *syphilis* and of *struma;* the disease is often started by injury.

CHAPTER XLIV.

DIAGNOSIS OF DISEASES OF THE FOOT.

Deformities.—When the ankle joint is extended and the heel is raised from the ground in standing, the deformity is known as *talipes equinus.* This deformity varies much in degree, and the patient ma walk on the ball of the toes or on the dorsum of the foot. The position of corns and callosities is a useful indication of the part of the foot upon which the patient walks. When the ankle is flexed, and the patient rests solely on the heel with the toes raised from the ground, it is *talipes calcaneus.* When the foot is rotated in at the transverse tarsal joint so that its inner border is raised and shortened, and is marked by a deep groove under the head of the astragalus, while the outer border is depressed and a corn or callosity is developed over the cuboid bone, it is *talipes varus.* If the foot be rotated out so that its outer border is raised from the ground and the peroneal tendons are tense while the inner border is depressed, it is *talipes valgus.* If the arch of the foot be abnormally deep, the patient resting merely upon the heel and the ball of the toes, it is *talipes cavus ;* while when the arch of the foot is lost so that in standing the whole length of the inner border of the foot rests upon the ground, and the head of the astragalus and tubercle of the scaphoid are unduly prominent, it is *talipes planus,* "flat-foot," or "spurious valgus." These forms of talipes are often combined ; thus, talipes equinus and varus are often associated, and talipes cavus may be superadded; talipes valgus and calcaneus are often found together, and in extreme cases of talipes planus some amount of equinus may be found.

Talipes is either *congenital* or *acquired.* In the latter the history must be carefully investigated with a view to tracing the deformity to the contraction of cicatrices or injuries dividing nerves (*traumatic*) ; retention of the foot for a long period in one position (*static*) ; paralysis of muscles (*paralytic*) ; and spasm of muscles (*spastic*) ; in the last case some source of *reflex* irritation or evidence of *neuromimesis,* such as intermission of the deformity, must be sought.

When the part is cold and livid, both smaller and shorter than its fellow, the skin rough and unhealthy, the talipes is certainly *paralytic*. The surgeon must notice how far and with how much force he can correct the deformity, and what tendons or bands of fascia become tense in so doing.

The great toe is often found pushed out of the straight line, and then a bursa is apt to develop over the head of the metatarsal bone; this is then known as a *bunion;* this bursa may become inflamed and suppurate. If a toe be bent back at the metatarso-phalangeal joint, and flexed at the two terminal joints, the deformity is known as *hammer-toe;* this may be accompanied by the development of a bursa over the head of the metatarsal bone in the sole.

The skin of the sole is often the seat of *corns* or *callosities* over the points of greatest pressure. If it be found with the cuticle greatly thickened and fissured in various directions, it is known as *psoriasis;* this is always syphilitic in nature. Irregular *fissures* and *ulcers* may be found between the toes in syphilitic patients, called *rhagades digitorum*. An ulcer may be found at either side of the nail of the great toe, most commonly the outer side, into which the edge of the nail presses; this is a cause of great pain, and is attended with discharge and the growth of a fleshy mass over the nail; it is known as *ingrowing toe-nail*. Ulcers are sometimes met with in the sole of the foot in the centre of what look like corns; they are very chronic in their course, and a probe is found to pass deeply in between the metatarsal bones, or to strike bare bone; they are known as *perforating ulcers*. The surgeon should examine the sensibility of the surrounding skin and the condition of the tendon reflexes, the gait and the pupil, and should enquire for "lightning-like pains in the legs," for these ulcers are often found in connection with local anæsthesia or locomotor ataxy. Sinuses are also met with in connection with disease of the bones and joints.

Tumours.—*Circumscribed ganglion* may occur on the dorsum of the foot as on the hand. If a firm tumour be found rising up under and displacing the nail of the great toe it is a *subungual exostosis.*

The bones and joints of the foot can easily be individually examined and any swelling or tenderness to pressure or movement can be readily determined, while the probe passed into sinuses may detect either necrosed or carious bone. By pressing each toe separately back towards the heel evidence of inflammation of the bases of the metatarsal and anterior carpal bones can be obtained.

Strumous disease of a tarsal bone is very prone to spread to one of its joint surfaces, and from the large size and complexity of the synovial membranes inflammation quickly spreads from them to several bones. The surgeon will be chiefly interested in ascertaining, by testing the movement of the foot upon the leg, whether the ankle joint is involved; then grasping the heel and instep in one hand and the metatarsus in the other, he will try to get movement between them at the great transverse tarsal joint.

Gout attacks the metatarso-phalangeal joint of the great toe with great frequency. If the great toe be chronically displaced outwards, and the usual prominence of the head of the metatarsal bone be greatly swelled, very painful, tender, reddened and fluctuating, there is a *suppurating bunion.* The abscess may burst and leave a sinus or may spread into the joint; this will be shown by the occurrence of grating and of great pain on moving the phalanx on the metatarsus. The acute inflammation of the bunion will be distinguished from gout by the history of the case and by the absence of the premonitory signs of gout. (*See* page 359.)

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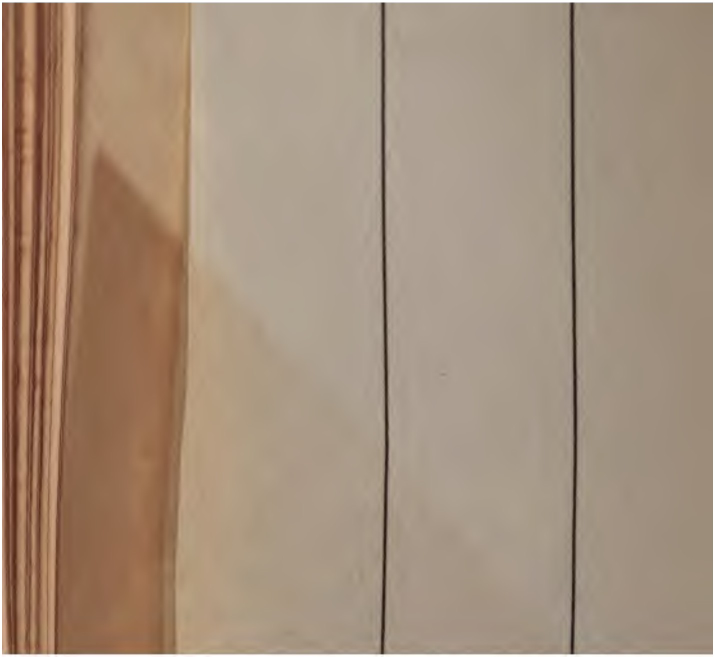

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